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A list of collaborators at home and abroad is being prepared and will be published at an early date. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

HISTOLOGICAL PICTURES REPRESENTING THE CURE OF UTERINE BASO-CELLULAR EPITHELIOMA.

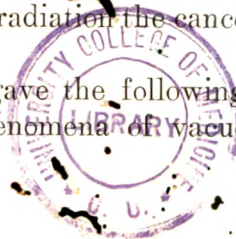
By Prof. Dr. FRANS DAELS (Ghent).

①

In introducing the subject I would remind you of what has been written relating to histological changes of malignant tumours after irradiation. I first show you a picture of typical cubic epithelioma of the breast before treatment (after Wickham and Degrais, high and low magnification), and the same tumour sixteen days after exposure to a radium irradiation at a depth of 2 cm. The phenomena of vacuolisation of the malignant tissue and sclerosis of the connective tissue are distinct. Under high magnification we see the lymphoid infiltration and the pycnosis of the nuclei.

In an epithelioma of the nose, according to Perthes, twenty-five days after X-ray irradiation a histological picture of regression in the shape of vacuolisation and infiltration was visible. Seven days after X-ray irradiation of a cancer metastasis arising in the skin of the breast from carcinoma mammae Perthes saw distinct phenomena of vacuolisation of cancer cells, which I now show you here, and seventeen days after the same irradiation the cancer already were reduced to a few degenerating cells.

An adenocarcinoma uteri, according to Gausz, gave the following picture ten weeks after mesothorium irradiation; the phenomena of vacuolisation,



pynosis, formation of giant nuclei and the development of connective tissue predominated, and three weeks later only a few remains of cancer tissue, lying in dead tissues, could be recognised.

Gausz treated with X rays a recurrence of cervical cancer in the abdominal operation scar, and four weeks later he observed the beautiful histological picture here shown : pynosis of the nuclei, caryorrhesis, formation of giant nuclei and the development of connective tissues are again the predominating features. After seven weeks he found only this small alveolus, which he considered to be the last remnant of cancer, but which, in the light of our knowledge, must be considered as the starting point of a recurrence.

Histological studies tend to show that the action of the X rays and of the radio-active substances upon the baso-cellular epithelioma are identical. The baso-cellular epithelioma is the most frequent form of uterine cancer, and it consists of full alveoli or bands of epithelial cells without any clearly marked differentiation. The researches show that after a latent period of ten to fifteen days hypertrophy of the protoplasm and of the nucleus of the cancer cells appears, malformation of the nuclei, eosinophilia of the protoplasm and abnormal phenomena of keratinisation follow. After that period there can be observed a vacuolisation of the protoplasm and of the nucleus, achromatosis or pynosis, caryolysis or caryorrhesis, accompanied by an infiltration of polynuclear leucocytes, phagocytosis of the degenerating cells, a more or less strong reaction of the connective tissue and endarteritis (Audin, Barthélemy, Darier, Kibbe, Peutrier, Pierre Marie, Ménétrier, Clunet, Perthes, Gausz, Dominici and Rubens Duval, Delbet and Herrenschildt, Wickham, Degrais and Gausz, Krönig, Döderlein, Bumm, and others).

The great majority of writers think that the giant nuclei and the giant cells are formed by abnormal and incomplete mitosis ; Händley, Klein and Dürck attach importance to fusions of cells ; Klein and Dürck attribute the formation of "conglutination giant cells" to the pressure of the sclerosed connective tissue upon the neoplastic cells. A well-defined action on the part of the various alpha, beta and gamma rays could not be demonstrated. The intensity of the irradiation is of the utmost importance.

The certainty of clinical and anatomico-pathological cure of malignant tumours as resulting from irradiation was demonstrated first by Dominici, and then by Wickham and Degrais. All the authors writing on the subject agree in concluding that various kinds of tumour can behave in quite different ways under the irradiation ; some of them seem absolutely refractory to their action.

The study of the histological phenomena of the processes of cure is important, both from the general point of view of the healing mechanism and pharmacodynamic influence of the irradiation, and also from that of the prognosis as to the action of radiation before and during a definite treatment.

In order to proceed methodically we have first studied the changes set up by the irradiation in a definite form and a definite localisation of a malignant tumour, namely, in selected cases of uterine baso-cellular epithelioma.

Uterine baso-cellular epithelioma is easily accessible to irradiation with radium tubes, to curettage for diagnosis and control, and to removal by the vagina. The baso-cellular epithelioma is not much differentiated, and consequently sensitive to irradiation without complicated phenomena of cell-differentiation.

We used for our irradiations two radium tubes of 50 mgr. of crystallised radiumbromide, one in a silver case and a brass case 1 mm. thick, the other one in a platinum case coated with lead 1 to 4 mm. thick; they were always wrapped with a thick covering of indiarubber and blotting paper. We followed the technique elaborated by our collaborator, Dr. De Backer, for the radium irradiation of the uterus, the vagina, the rectum and the bladder, and the simultaneous employment of X rays applied to the sacro-sciatic and the oval foramina. The evidence obtained from micro-photographs taken till now is important. We confine the description of our observations and their interpretation only to what is strictly necessary. I shall only demonstrate to you the typical modifications of the malignant tissue after irradiation as we have observed them. I shall not mention in this first paper the particulars of our technique of radiation, because the details of this technique are still in a state of evolution.

Case 1.—D. C. Inoperable uterine baso-cellular epithelioma, spreading into the left parametrium, and growing into the wall of the bladder. Diagnostic curettage. Baso-cellular epithelioma, strongly infiltrating. Some indications of formation of giant nuclei. Necrosis almost completely absent.

Irradiation with radium bromide, 50 mgr., filtration 0.5 mm. of platinum and $1\frac{1}{2}$ mm. of lead, and 50 mgr. with filtration 0.5 of brass and 1 mm. of lead in the cavity for 62 hours. Irradiation with the two tubes through the rectum for 12 hours. After 6 days, fresh irradiation of the cavity for 18 hours. Seven days after the irradiation a small portion of tumour was removed. The phenomena of pycnosis and achromatosis of the nuclei, of giant degeneration of cells and nuclei, of vacuolisation and eosinophilia, of necrosis of the cells, of polynuclear infiltration and phagocytosis were distinctly present, and even eosinophilia of the degenerating nuclei (Figs. 1 and 2). These phenomena appeared to prove massive necrosis of the tumour. In addition to necrosis we also observed an appearance of violent caryorrhexis, that is, the alteration of the cancer alveolus, which was rupturing into innumerable extremely thin chromatin granules, but these observations were made in the midst of dead tissues (Fig. 3). Nineteen days after massive irradiation we found in a section just removed mixed infiltration with giant cells without any evidence of cancer, but exhibiting the same structure as the giant cells of classical tubercle, sometimes with well-defined nuclei situated peripherally or sometimes invaded by leucocytes (Figs. 4, 5, and 6). In this case there were present phenomena of necrosis and phagocytosis and caryorrhexis of the cancer cells and of the normal tissues as well. These phenomena cannot be considered in the light of a selective alteration of the malignant tissue. The presence of giant cells is an interesting feature.

Case 2.—Desm. Inoperable uterine baso-cellular epithelioma. Both parametria involved. Diagnostic curettage August 25th, 1920. Within a week irradiation through the cavum uteri and the cervix uteri with 50 mgr. radium bromide, filtration 0.5 mm. of lead, for 23 hours; through the rectum for $9\frac{1}{2}$ hours, through the bladder during 4 hours. Two weeks and a half later and within 3 days 100 mgr. radium bromide for 12 hours in the vagina, 50 mgr. for 5 hours in the bladder and 12 hours in the rectum. Three days later, hysterectomy. Sixteen portions of the uterine and parametric tissues were examined. In some parts of the uterus and of the parametrium we still found distinct but recognisable cancerous margins. Representations

of the changes undergone by the tumour were demonstrable: necrosis of the centre of the cancer alveoli with the remnant of a slight cancer margin in pycnosis and karyolysis (Fig. 7); complete karyorrhexis of cancer alveoli, a true rupture of the nucleus and dissemination of chromatin granules (Fig. 8); appearance of giant cells without signs of nuclei multiplication. In some regions we found infiltration of lymphocytes. Radium therapeutic drainage of the true pelvis. Control irradiation. The patient remains quite healthy to this day. The most important point in these observations is the massive karyorrhexis of cancer alveoli and the presence of giant cells.

Case 3.—E. M. Recurrence in the vaginal scar after hysterectomy for uterine carcinoma carried out by another surgeon. Wide cavity. Adhesions to the bladder. Baso-cellular alveolar epithelioma. Slight necrosis. In the region of the necrosis infiltration of polynuclear cells. Well marked infiltration of lymphocytes in the cancer alveoli. No giant cells. Tendency to formation of giant nuclei in the region in which the infiltration of the lymphocytes was pronounced.

Ten days later irradiation with 50 mgr. of radium bromide, filtration 0.5 mm. of platinum and 0.5 mm. of lead, in the cavity of the tumour for 36 hours; we removed a few portions of the tumour. We observed all the phenomena of a marked necrosis of the cancer alveoli, appearances which are never associated with spontaneous degeneration. Pycnosis or achromatosis of the nuclei in the centre of the alveoli, eosinophilia of the protoplasm, vacuolisation (Fig. 9). Penetration of the polynuclear leucocytes into the necrosing elements (Fig. 10). The more peripherally situated nuclei of the cancer alveoli had undergone alteration into giant formations (megakaryocytes) or into large vacuolised cells with giant nuclei. Complete necrosis with interference of the white polynuclear leucocytes (Figs. 11, 12, and 13). We observed similar phenomena in different cases treated in the same manner. We consider these phenomena of destruction and absorption of the cancer alveoli as representing a typical cure.

Case 4.—Colp. Inoperable uterine baso-cellular epithelioma; wide cavity; both parametria were deeply involved. Curettage, January 25th, 1919. Alveolar baso-cellular epithelioma without differentiation. In some areas of the tumour there were visible phenomena of pycnosis (uniform dark colouring of the nuclei without differentiation) and of achromatosis (failure of the nucleus to take the stain), vacuolisation of the protoplasm and fatty degeneration. Giant nuclei present in a very small number and well differentiated. Some cancer alveoli were entirely necrosed. Preponderating infiltration of lymphocytes. Irradiation with a tube of 50 mgr. crystallised radium bromide, embedded in the tumour for 24 hours. During three consecutive weeks, a weekly irradiation lasting 13, 18, and 14 hours. A month afterwards vaginal hysterectomy; the cavity was converted into a scar. Six portions of tissue were removed from different areas of the cervix uteri, fixed in formalin and in Fleming's solution, and examined microscopically. In addition to the various forms of superficial necrosis with infiltration of polynuclear and lymphoid cells, we observed special histological changes indicative of cancer cure.

We found the cancer alveoli formed in some portions of slightly vacuolated or fatty degenerated protoplasm with giant masses of chromatin, giant nuclei in pycnosis, which appeared to originate from fusion of necrosing cancer nuclei, true areas of megakaryocytic nuclei (Figs. 14, 15, 16, and 17). In some protoplasm can be recognised the sole remnants of a nucleus, as shown in the photographs; elsewhere there was a simple collection of fat granules. We found those megakaryocytic forms in places in which no noticeable infiltration of white blood-cells is discoverable; consequently they were not necrosing masses which act as a foreign body and attract movable cells; they rather seemed to be elements in a state of spontaneous regression in consequence of the irradiation they underwent four weeks before. The absence of free movable cells in the vicinity of these megakaryocytic formations cannot be ascribed to an action of the irradiation upon the movable cells of the tissues, since this irradiation took place several weeks before and the infiltration was present in the other areas of the tumour.

Those megakaryocytic formations were found in the midst of apparent normal muscular tissue; so they were the expression of a selective regression. Around these megakaryocytes we nearly always found empty spaces which give evidence of the disappearance of the cancer cells. Besides

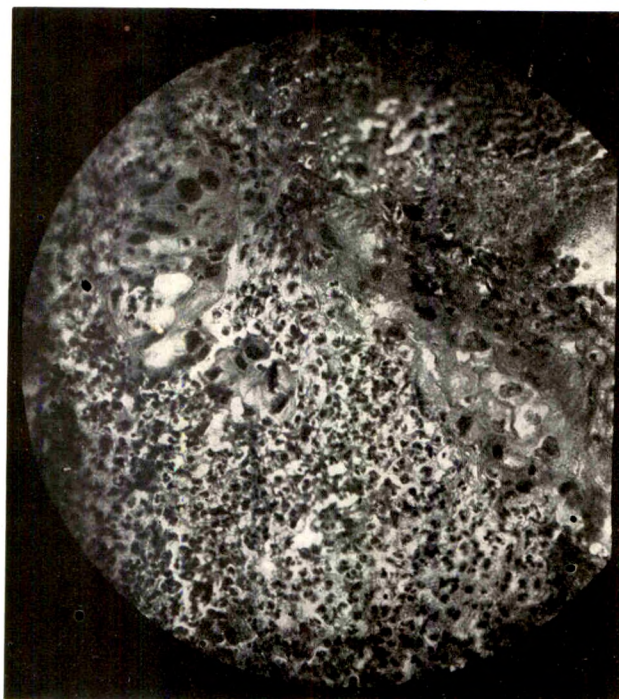


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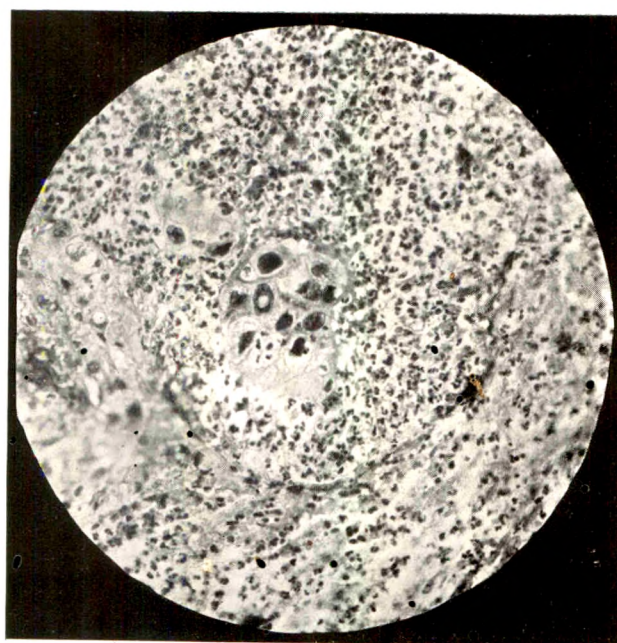


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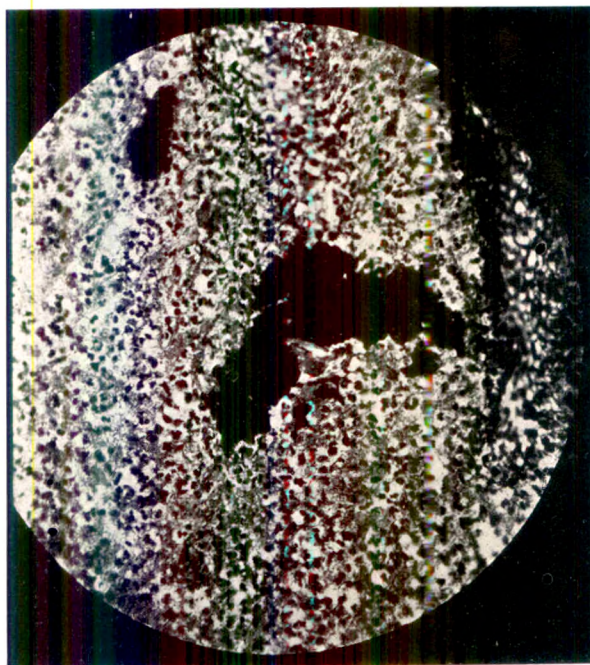


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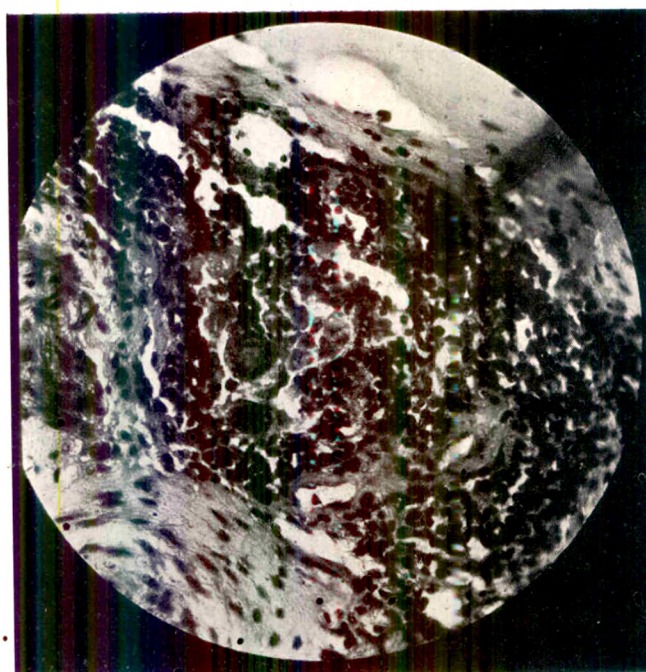


FIG. 4.



FIG. 5.

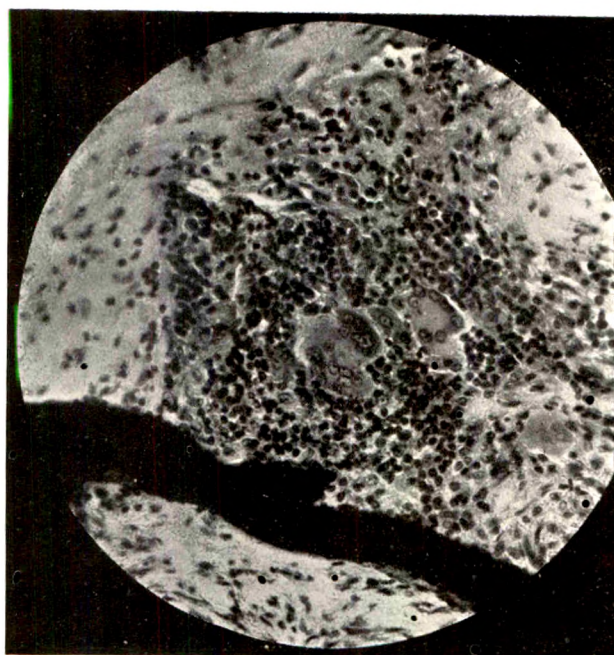


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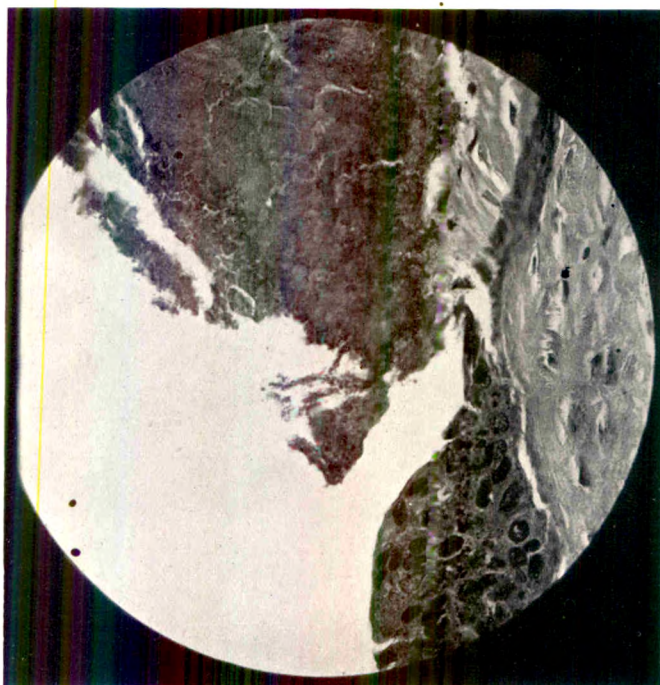


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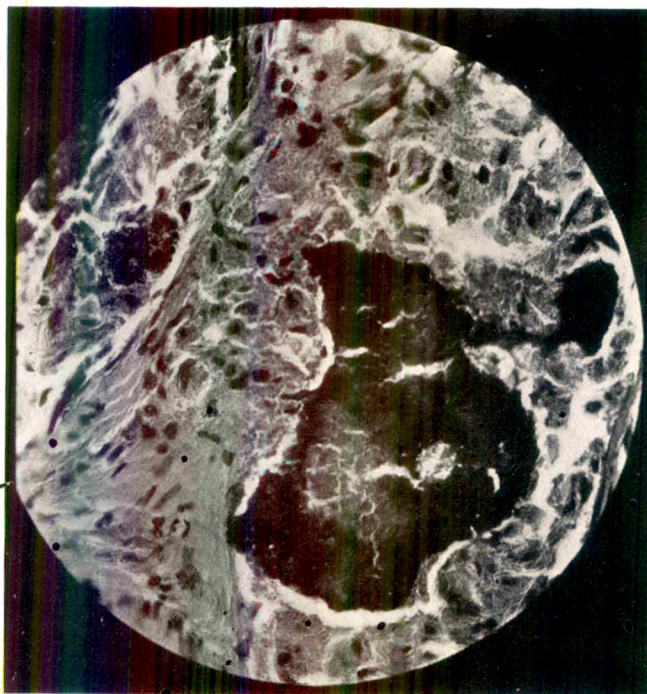


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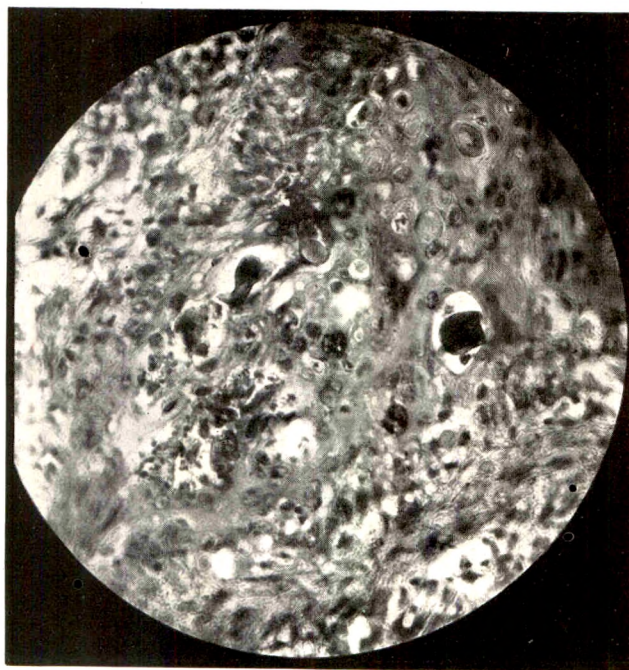


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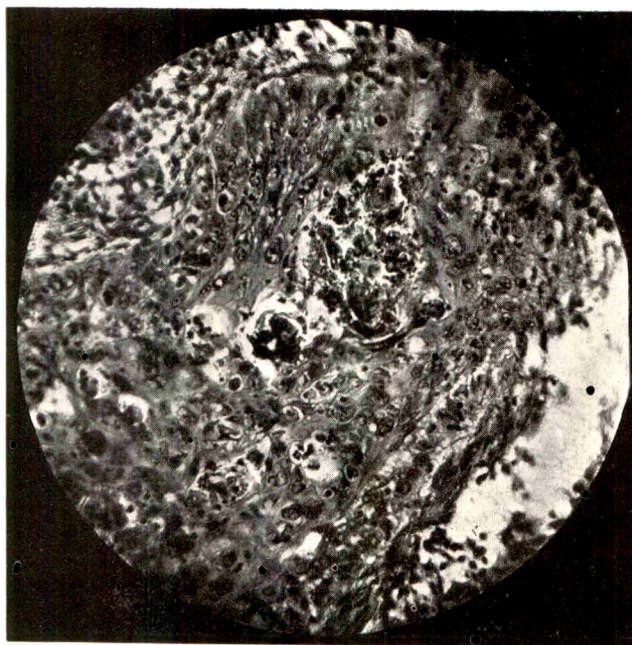


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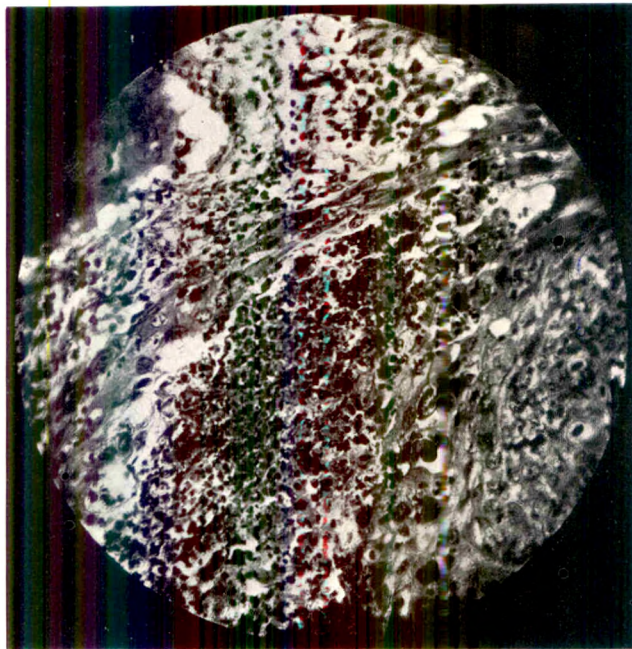


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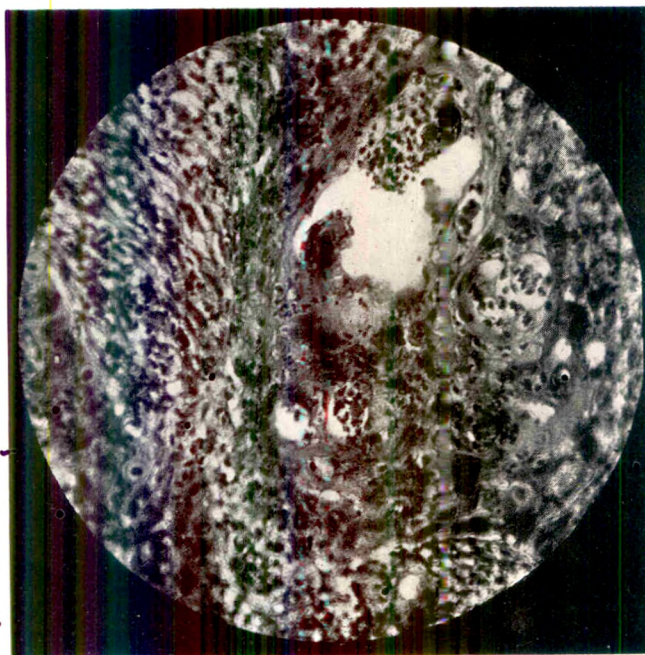


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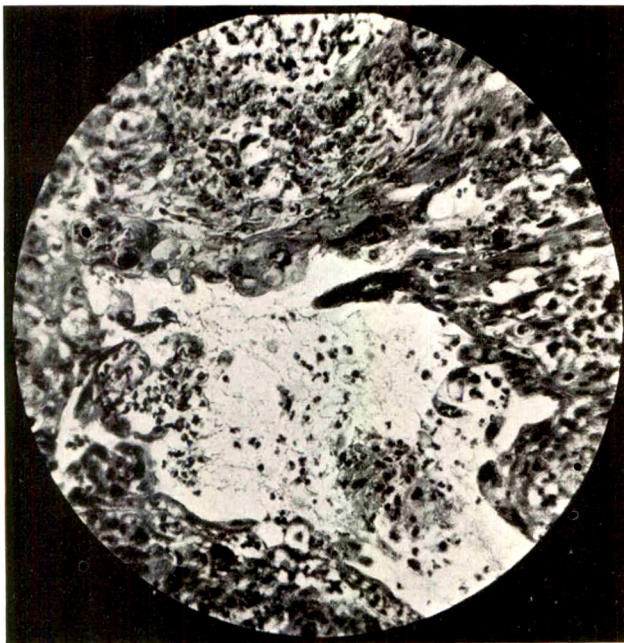


FIG. 13.

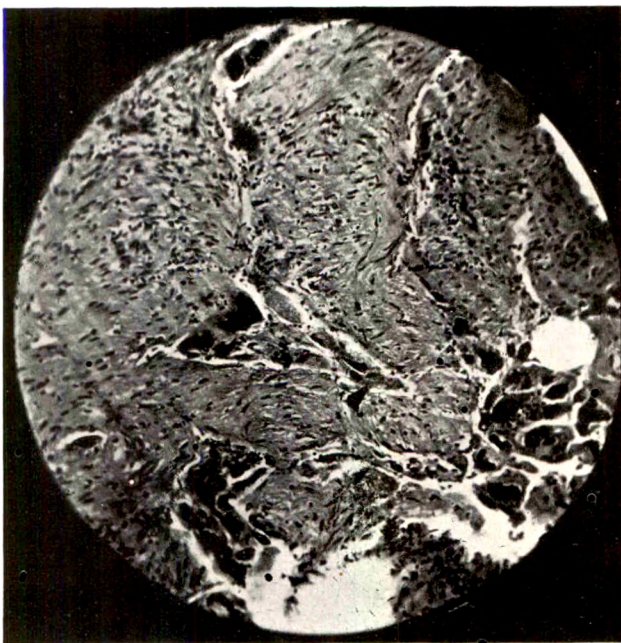


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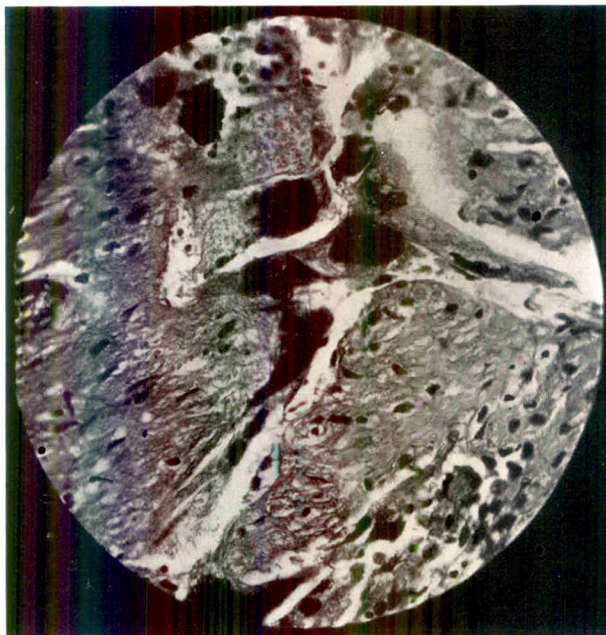


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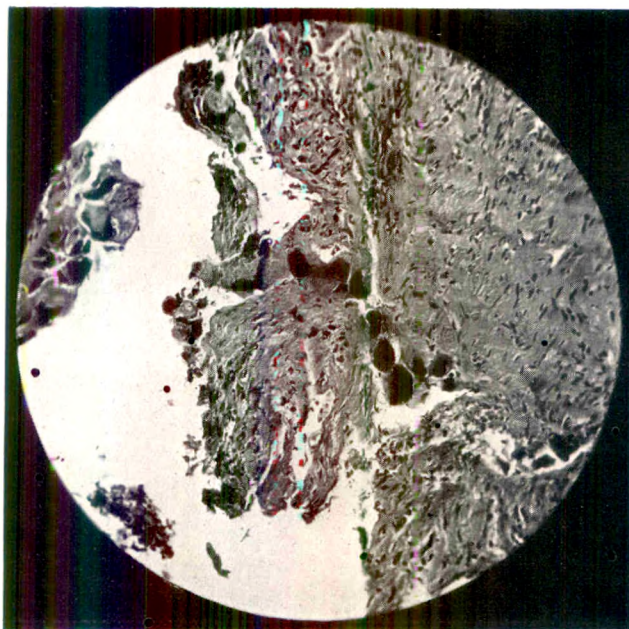


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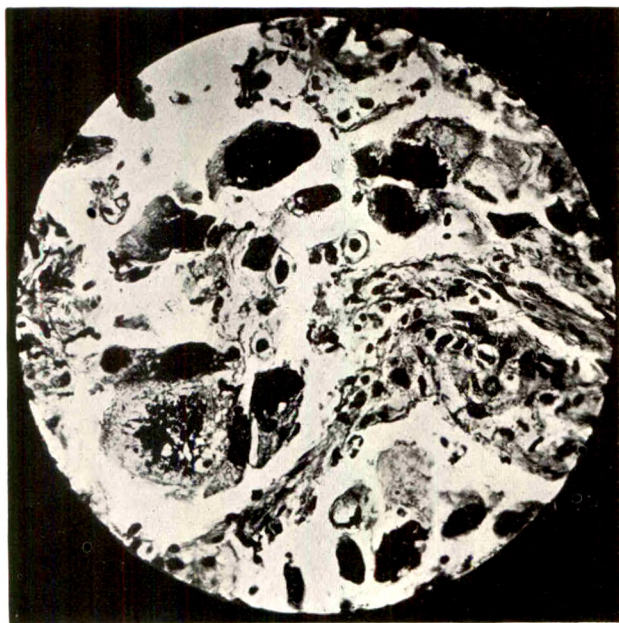


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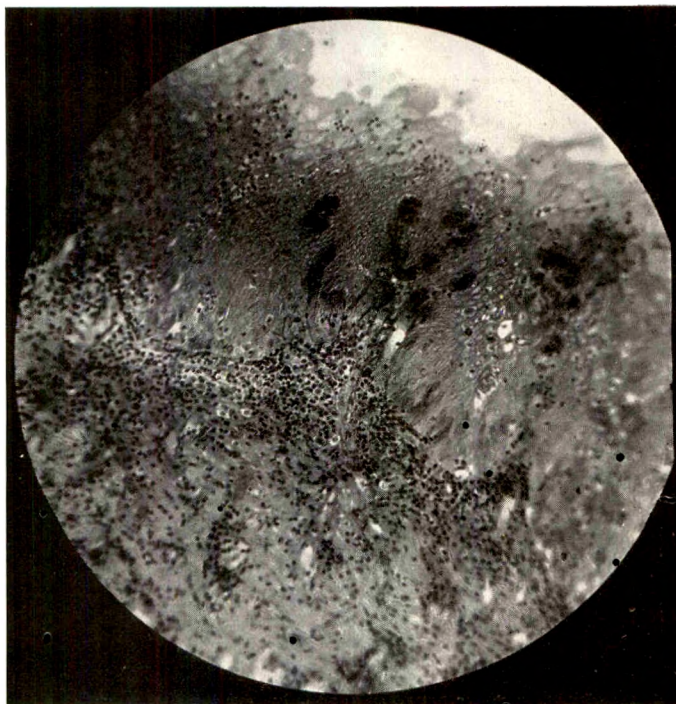


FIG. 18.

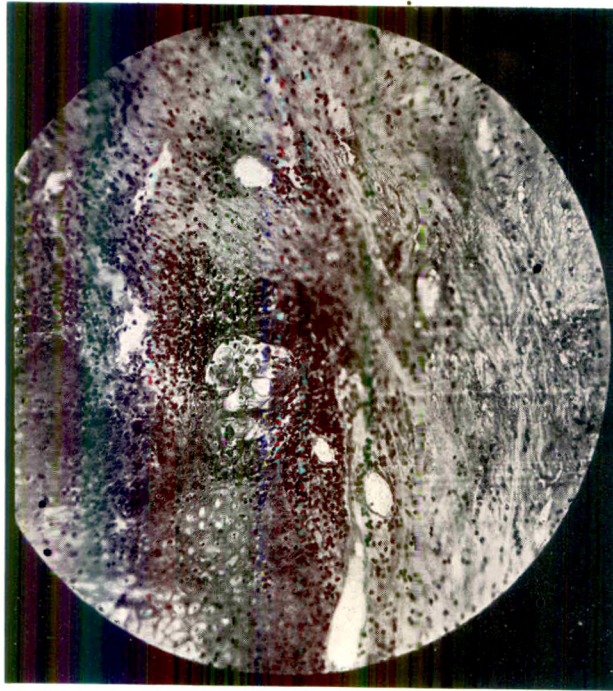


FIG. 19.

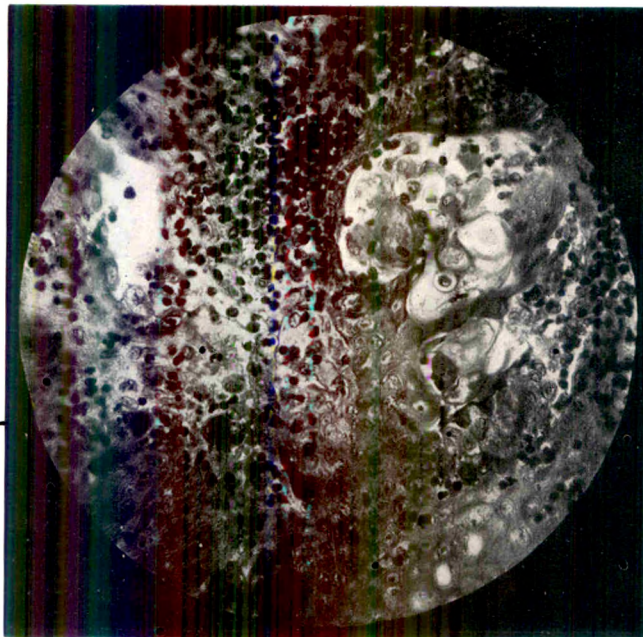


FIG. 20.

those histological pictures we found alveoli in vacuolisation, in pycnosis, in nuclear degeneration, besides other cancer cells multiplying rapidly, as testifying to the inefficiency of the irradiation in this case. The patient refused all further treatment, and died from recurrence about a year later. So we saw in this case a regression of the malignant tissue with formation of giant cells and giant nuclei, and megakaryocytic formation, which demonstrate the progressive disappearance of the protoplasm and nuclei, a phenomenon quite different to the massive necrosis and absorption in the cases first mentioned. Here we recognise a most selective way of destroying the malignant tissue.

Case 5.—D. M. Inoperable uterine epithelioma extending over both parametria. Throughout 10 days, during 32 hours, irradiation of the cavity with 100 mgr. of radium bromide, and for 10 hours irradiation with 50 mgr. of radium bromide with filters of 1 to $1\frac{1}{2}$ mm. of lead, 100 mgr. radium bromide in the rectum for 11 hours; 50 mgr. radium bromide in the bladder for 4 hours. Hysterectomy after 22 days. At the microscopical examination we only found sclerosed tissue. In the tissue of the left parametrium we found an accumulation of giant cells,

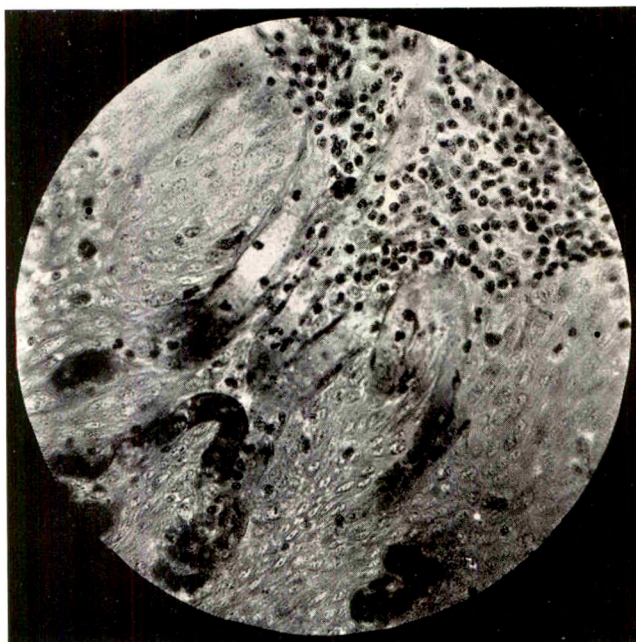


FIG. 21.

which were shaped like cancer alveoli; in other areas we found giant cells surrounded by lymphoid infiltration, a typical picture of tubercles. A small piece of tissue removed from the vaginal scar six months after was sprinkled with giant cells but did not show typical follicles. The patient underwent radiumtherapeutic drainage of the true pelvis and two control irradiations. She has remained till now clinically cured.

Case 6.—D. W. Broad uterine baso-cellular epithelioma, extending into the vaginal wall on the right side. Flabby masses. Hard parametria. Microscopical: baso-cellular epithelioma without differentiation and with scanty necrosis. October 7th, 1919, curettage. Radium tube of 50 mgr. of crystallised radium bromide in a platinum case and india-rubber coating placed in the cervix uteri for 12 hours, and another tube in a silver case, 0.5 mm. of brass and india-rubber wrapping under the cervix uteri. Sensibilisation of the tumour with colloid platinum. November 10th, 1919, we only found a small erosion left. The radium tubes were applied again in the same way. November 28th, 1919, vaginal hysterectomy. From that corner of the right parametrium at which the great blood-vessels branch off we removed a lymphatic gland

the size of a pea, flabby and dark red. Twelve portions of tissue were removed from different areas of the cervix uteri. We could not detect cancer cells in any of these pieces of tissue. We did not observe anything except lymphocytic infiltration, hæmorrhages in the necrosing masses, coagulated blood-vessels and tissue proliferation from the intima, besides vacuolisation of the media. In the superficial scar of the cervix uteri we found a lymphoid infiltration of the subcutaneous cellular tissue (Fig. 18), in some places irregular epidermoid formations situated in the subcutaneous tissue and surrounded by a compact lymphoid infiltration (Figs. 19 and 20); elsewhere we met with an abnormal capillary formation in the epidermis (Fig. 21) and the presence of giant nuclei (Fig. 22). The patient underwent later on two control irradiations, and she remains clinically cured.

CONCLUSIONS.

In proportion to the intensity of the action of the irradiation upon the cancer cells of the uterine baso-cellular epithelioma we observe the following

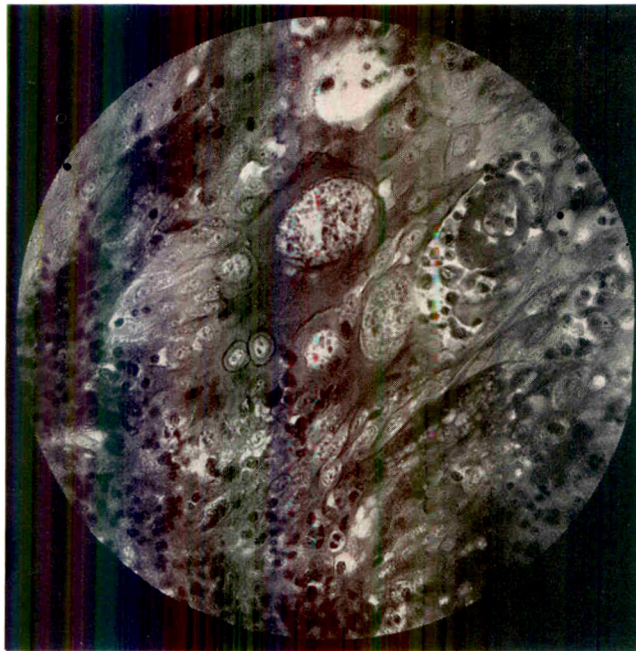


FIG. 22.

phenomena. They are changes not met with in cases of spontaneous degeneration, namely:—

(1) Massive and rapid karyorrhexis of the cancer cells without any intervention on the part of the blood cells or any profound degeneration of the normal tissues.

(2) Progressive necrosis occasioned by pycnosis or achromatosis with eosinophilia or vacuolisation of the protoplasm and phagocytosis by polynuclear blood cells; this destroys quite a large number of alveoli; this well marked phenomena is here specially characteristic of the action of the irradiation.

(3) The transformation of the cancer cells into giant cells and giant nuclei, an alteration that may lead to necrosis with invasion by polynuclear leucocytes, or to a gradual atrophy with fatty degeneration of the protoplasm and disappearance of those elements without any participation of leucocytes in the process.

The action exercised by the irradiation—radium irradiation more especially, but, however, not exclusively, since we often added irradiation by X rays after radium treatment—first affects the nucleus and sets up an actual rupture of the nucleus comparable to the action of the irradiation upon the lymphocytes; or else a destruction of the nucleus, sometimes combined with eosinophilia or the megakaryocytic-shaped degeneration which seems to result from nuclear fusions due to loss of karyokinetic power.

Our observations lead us to admit that the polynuclear leucocytes only occur in association with spontaneous degenerations or with radiotherapeutic transformation of the baso-cellular epithelioma, as a consequence of incidental infections or the necrosis of cancer cells, and that they do not take an active part in the elective regression proper. And so we must also admit that the connective tissue has no active participation in the regression proper, as we meet with the most excellent expression of regression in the midst of the empty space remaining after the disappearance of the cancer cells. On the contrary, it seems that a special significance of effective reaction against the cancer proliferation or its agent must be ascribed to infiltration of lymphocytes.

(4) The appearance of giant cells without the characteristics of malignant tissue, sometimes with a distinct follicle shape, the appearance of true histological follicles as a consequence of radium irradiation of cancer alveoli, lead us to the adoption of the hypothesis of the liberation of substance to which the body is supposed to react by lymphocytic infiltration and formation of giant cells. The histological appearances found upon the healing of the follicle that arises after experimental injection of killed Koch bacilli should be remembered in this connection, namely, formation of giant cells, fusions of the nuclei, formation of megacaryocytic elements, progressive liberation and atrophy of those megacaryocytes. These phenomena have the greatest resemblance to those observed in the case of cancer regression.

A CASE OF OSTEITIS DEFORMANS.

By H. WALLACE JONES, M.Sc., M.D., M.R.C.P., Hon. Assistant Physician, Liverpool Royal Infirmary; and C. THURSTAN HOLLAND, Ch.M., Hon. Consulting Radiologist, Liverpool Royal Infirmary.

Osteitis deformans has always been looked upon as a rare disease ever since 1876, when Sir James Paget¹ drew attention to this condition by a series of five cases, and up to 1914 only 213 cases had been recorded in medical literature.

The history of this case, which shows very typically the X-ray appearances of the disease, was that of a man, age 55, who for the last five years had suffered from pains in the back and legs with some muscular weakness. As is often the case, the pains were thought to follow a slight accident to the right hip a short time previously. There is no family history of similar disease. The man, as the photographs show, has a hunched-back appearance with marked kypho-sclerosis of the spine with curvature in the dorsal region

to the right. Movements of both hip joints are limited, especially abduction and flexion. The iliac crests are thickened and rougher than normal and were very tender on pressure. The tibiae, especially the right, show well marked bowing forwards and outwards with some irregular nodules along the anterior surfaces. Both shoulders and the right elbow joint are very stiff and creak on movement. The clavicles are rather broad and rough and are tender on pressure. The skull is considerably enlarged, and the patient states that the size of his hats has increased from $6\frac{7}{8}$ to $7\frac{1}{4}$; there is no change in the shape of the lower jaw. He has also lost 2 in. in height during the last four years. The heart is normal in size, but there is some accentuation of the aortic second sound with a raised blood pressure and general arterio-sclerosis.



FIG. 1.

Blood examination shows :—

Inorganic phosphorus, 3.99 mgms. per cent.

Uric acid, 2.6 mgms. per cent.

Non-protein nitrogen, 33.3 mgms. per cent.

Sugar, 105 mgms. per cent.

The X-ray appearances in this case are typical of the disease and are very general. The varying stages of the disease as bone is affected are shown in both tibiae, in the right femur, in the tarsal bones of both sides, in the right forearm, left wrist, left carpus and metacarpus, and in the skull—these were all the areas radiographed.

It is now generally accepted that the essential features pathologically are a combination of a rarefying with a proliferative osteitis, and that the varying X-ray appearances will depend (in addition to the stage of the disease) upon which of these processes is in the ascendant.

The radiograph of the skull in this case is very typical and is practically diagnostic in itself. These skull changes are frequently a very early feature, and, apparently the disease usually commences in a single

bone, in the skull or in a tibia, and spreads from this, so to speak, focus.

Some difficulty might arise, if only one tibia was affected and radiographed, in deciding between syphilis and Paget's disease, but in such a case a radiograph of the skull and a negative Wassermann reaction would probably decide the diagnosis. In an early stage of the disease it might also be radiographically difficult to distinguish it from osteitis fibrosa.

REFERENCES.

- 1 Paget, J., *Med. Chir., Trans.*, Lond., 1872, Vol. LX, p. 37.
- 2 *Illus. Med. News.*, 1889, Vol. II, p. 181. Hutchinson, J., *Illus. Med. News*, 1889, Vol. II, p. 169.
- Chastel, "Contribution à l'étude de l'ostéite déformante de Paget," Thèse de Paris, 1910.
- Da Costa, J. C., Funk, E. H., Bergeim, O., and Hawke, P. V., *Proc. Amer. Soc. Biolog. Chemists*, Balt., 1914, Vol. XVII, No. 2, p. xxx.
- Legros G. and Leri, A., "Nouvelles iconographies de la Salpêtrière," Paris, 1909, Vol. XXII, p. 24.
- Cone, Sidney M., *Journal of Bone and Joint Surgery* (with full bibliography), October, 1923, p. 751.
- Jones and Lovett, *Orthopaedic Surgery*, p. 317.
- Baetjer and Waters, "Injuries and Diseases of the Bones and Joints," p. 323.



FIG. 2.



FIG. 3.

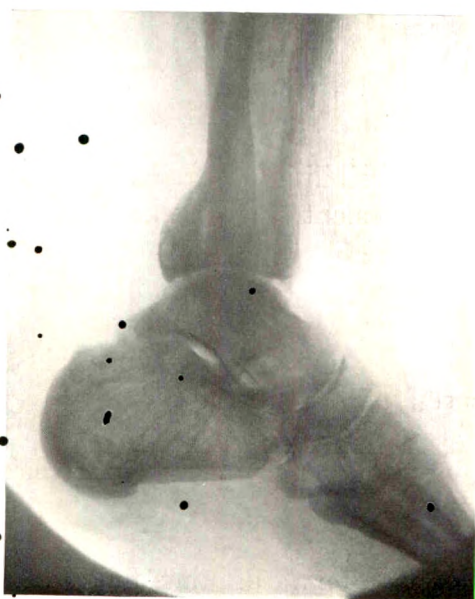


FIG. 4.

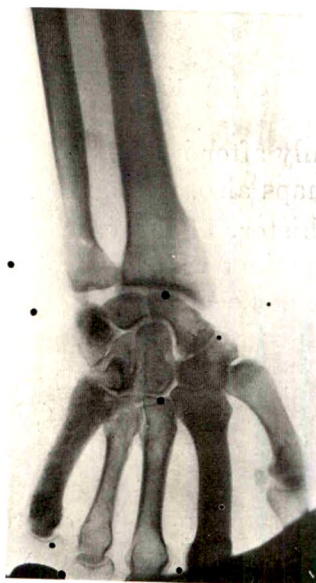


FIG. 5.

ARTIFICIAL PNEUMOPERICARDIUM.

By R. W. A. SALMOND, O.B.E., M.D., Ch.M., Honorary Radiologist, University College Hospital.

It is probably safe to say that most of the more recent advances in radiological diagnosis have been made by the artificial introduction of air or other gas into various parts of the body. The following case illustrates the value of air injection into what is probably an unexploited region, namely, the pericardium. It is frankly acknowledged that this injection was made accidentally, and that

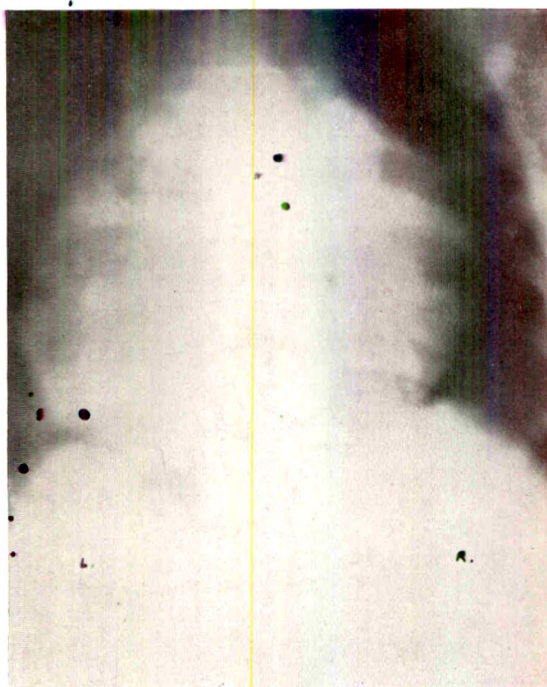


FIG. 1.

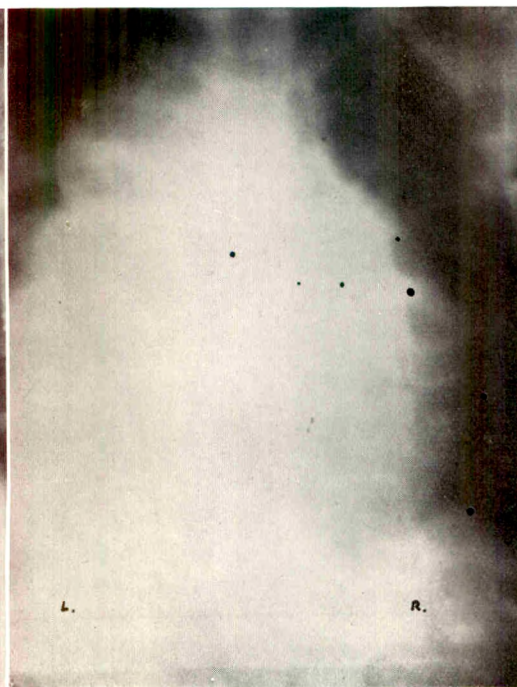


FIG. 2.

it was only after it had been done that its possibilities as regards diagnosis and perhaps also, to a much lesser extent, treatment, were seen.

The history of the case is briefly as follows :—

The patient was twenty-one years of age, and an electrician by trade. On June 1st he became conscious of dyspnoea followed by pericardial pain. Three weeks later, while running to catch a bus, he felt a sharp pain in his chest and nearly fainted. He presented himself at hospital, and on examination showed dyspnoea, but no cyanosis, slight oedema of the ankles and a large effusion in the pericardium. He was admitted to hospital under the care of Professor T. R. Elliott.

A week later his pericardium was tapped and about thirty ounces of brownish-red fluid withdrawn. A month afterwards the fluid had re-accumulated and he was again tapped, fifty ounces of fluid being removed.

The character of the fluid was much as before, except that it contained some fresh red blood cells. On the 6th August he was sent to the radiological department for examination. This showed a much enlarged cardiac shadow, with no definite pulsation, and was obviously a condition of hydropericardium. Fig. 1: In the oblique view nothing could be made out in the posterior mediastinum on account of the enlarged pericardial shadow extending backwards. A week later another paracentesis was performed and forty ounces of amber-coloured fluid removed from the pericardial sac. Soon after this patient discharged himself, as he felt so much better and was able to get about.

Two months later, in October, he was readmitted, obviously much worse, more dyspnoeic and with a larger amount of fluid in the pericardium, but with no evidence of venous congestion. Another X-ray examination showed a

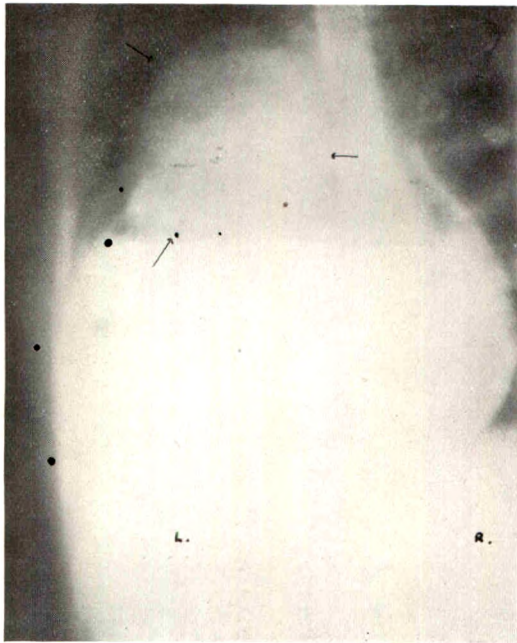


FIG. 3.

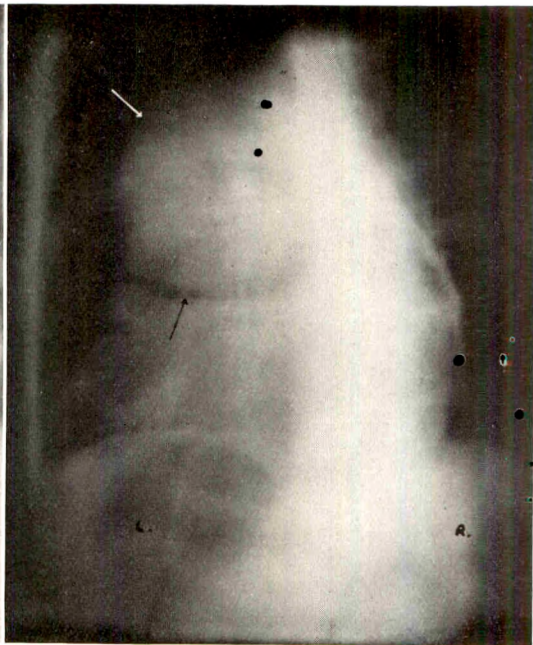


FIG. 4.

further enlargement of the pericardiac shadow. Fig. 2: A month later Professor Elliott did a paracentesis to the right of the sternum and removed seventy ounces of amber-coloured fluid. There was no distress during the puncture, but during the afternoon he showed signs of collapse, cyanosis, feeble pulse and vomiting. On the following day a right-sided pneumothorax was diagnosed by Dr. J. W. McNee. Two days later the patient was quite comfortable, there were no signs of pneumothorax, but Professor Elliott found definite physical signs of hydro-pneumopericardium, and this was confirmed by X-ray examination. Fig. 3: This showed a free fluid level in the pericardium with air above, and what was more important, a defined mass to the left of mid-line. This was the first time that it had been able to demonstrate with any certainty the tumour or cyst, as it eventually proved to be.

Ten days after, another X-ray examination showed a further point of

interest, namely, that the fluid in the pericardium was now becoming absorbed, and at about the same rate as the air. Fig. 4: A week later a further examination showed the pericardium to be much more normal in size, and the definite mass above and to its left showed slight pulsation. Fig. 5: The pericardium ultimately became normal as regards fluid, while progressive bulging with communicated cardiac pulsation over the first, second and third intercostal spaces appeared as the result of the enlargement of the cyst.

The opinion having now been come to that this must be some kind of tumour, either in or close to the upper left part of the pericardium, it was decided that an operation should be done. The patient readily agreed, and it

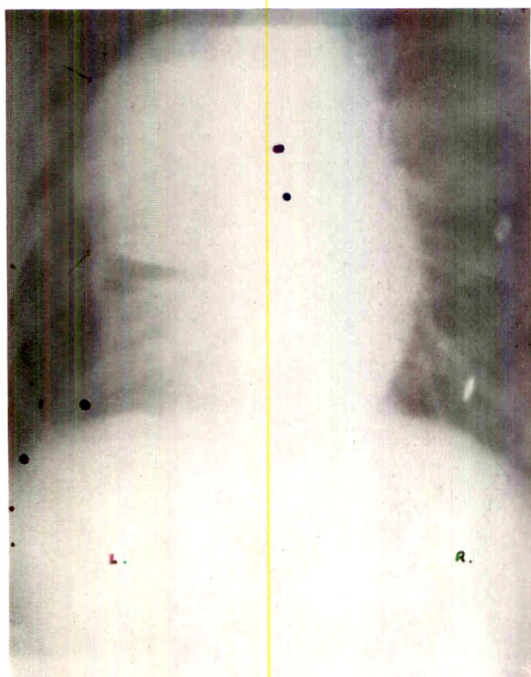


FIG. 5.

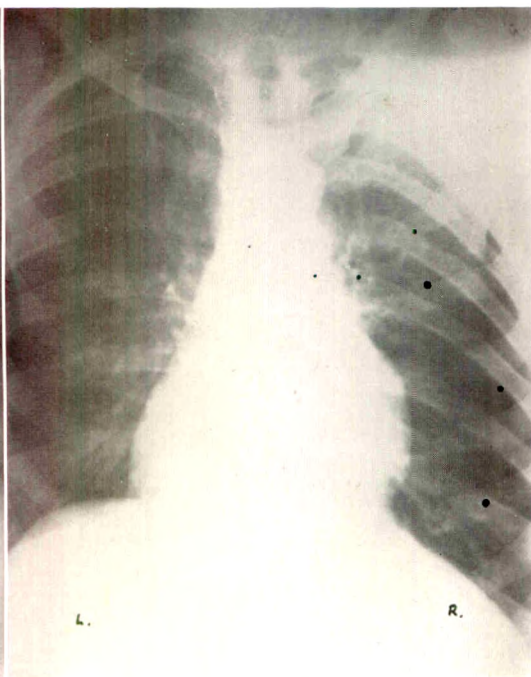


FIG. 6.

was performed one week later by Professor G. E. Gask, of St. Bartholomew's Hospital, with most successful and brilliant results. The sternum was split, but neither the pleural nor pericardial sacs opened. A large cyst, containing forty ounces of greenish-yellow fluid, was found closely adherent to the upper left aspect of the pericardium. It had been leaking into the latter and had been the cause of the fluid there. As much cyst wall was removed as was possible and a drainage tube inserted. Microscopically, the cyst wall was thick, vascular and contained cartilage, plain muscle, mucous glands, and was lined with ciliated epithelium. The patient made a splendid recovery, and six weeks later was able to walk up to hospital and have another X-ray record made. Fig. 6: This shows to all intents and purposes a normal chest. Two and a half years have now elapsed since the operation, and he is in very good health and able to cycle and do his ordinary work.

One of the many points about this case is how the air got into the pericardial sac. Professor Elliott assures me that none got in by way of the syringe when paracentesis of the pericardium was done. The most likely explanation then is that the needle on its way to the pericardium passed through collapsed and compressed lung. As the distended pericardial sac diminished in size from the withdrawal of its fluid, the lung was enabled to expand and so produce the pneumothorax which was found the day after the puncture. Later the air in the pleural cavity gradually filtered into the pericardium through the needle puncture, no doubt helped by the systole and diastole of the heart.

Another point was the effect of the air inside the pericardium. It at once started the absorption of the fluid in the pericardium, and the leakage from the cyst ceased. It is a question of medical interest whether, in the more usual cases of pericardial effusion, the introduction of air would start or help to start a similar absorption. This has been tried in cases of pleural effusion after some of the fluid has been removed. In these cases the air causes the lung to collapse and so puts it at rest, but in the case of the heart, this is naturally a much more delicate proposition.

The case described is, no doubt, an exceptional one, but it is felt that in certain suitable cases the artificial introduction of air or other gas into the pericardium would be of much diagnostic value. The present case would have, almost certainly, terminated fatally if the cyst had not been revealed by X rays and followed by so successful an operative result.

In conclusion, I wish to gratefully acknowledge the generous help of Professor Elliott and his assistants for the medical notes, and to Professor Gask for the surgical notes of the case.

PULMONARY TUBERCULOSIS AS SHOWN BY X RAYS, BUT WITHOUT PHYSICAL SIGNS.

By STANLEY MELVILLE, M.D.

Reprinted, with permission, from "The Proceedings of the Royal Society of Medicine, Sect. Elec.," May, 1923.

ONE of the greatest clinicians and pathologists of our day has lately written a book on "Pulmonary Tuberculosis." He refers to a series of combined examinations made at a military hospital—on the one hand by himself, and on the other hand by a radiologist of gracious memory—with the object, as he avers, of proving for his own work the value of X-ray examination in the diagnosis of pulmonary tuberculosis. "In no case," says the writer, "did X rays indicate the presence of unsuspected disease." Now, such a statement, coming from one of the writer's eminence, was so diametrically opposed to my own personal experience (and I venture to say to that of most of my colleagues) that I scrutinised the sentence carefully. The word "unsuspected" seemed

to me to be a word capable of many readings, and I began to wonder whether the writer might not be having a little joke at our expense. Surely, to the clinician experienced in chest work, there is much suspicion of disease even in cases which show no physical signs, such suspicion amounting almost to a certainty. If this was the meaning of the writer, then I think we shall all be in agreement with him; if his meaning was otherwise, then I think our time will not be wasted if we consider a few typical cases. I make my contribution in no spirit of criticism, but as a plain statement of fact and rather in a spirit of admiration for the honesty of great clinicians who can admit fallibility. I believe that our art is but one factor in diagnosis (though I do not minimise its

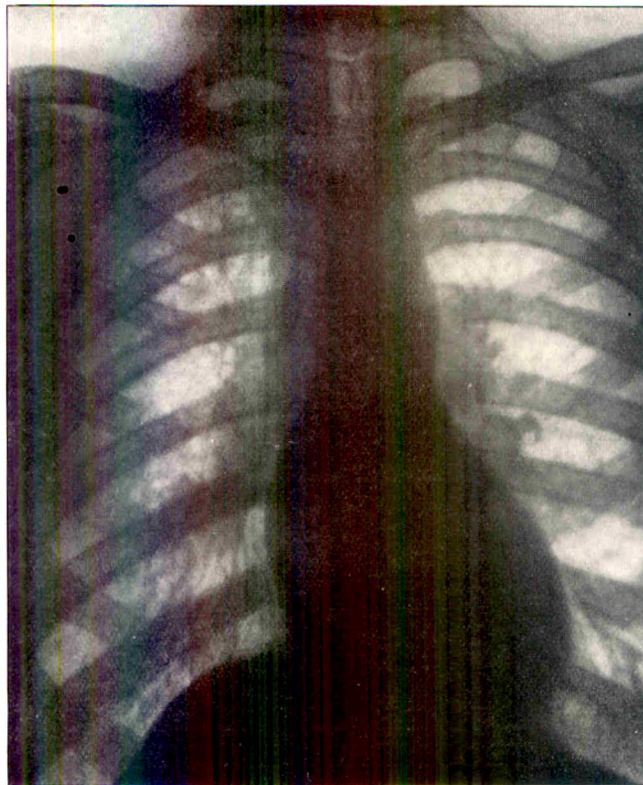


FIG. 1.—Case 2.

importance), and that it will only be by constant "team work" that we shall arrive at the truth.

Now, the cases which I show you to-night, without exception, are cases in which, after careful examination by competent physicians, no physical signs were found. That suspicion of tuberculous disease was present in the minds of those physicians was obvious—indeed, in some of the cases tubercle bacilli were actually present.

I do not feel competent to offer any explanation of the apparent absence of physical signs, except upon two points:—

(1) That the presence of slight emphysema tends to mask physical signs, and emphysema was present in certain of my cases.

(2) That abnormalities in the percussion note and in the breath sounds are, I believe; not readily detectable at a greater depth than about 4 mm. from the lung surface where the area of infiltrated lung is small in extent.

The following are notes of the cases which I have selected for consideration:—

CASE 1.—Male, aged 54. T.B. negative six times. History: Cough, sputum, dyspnoea, bronchitis and pleurisy, hæmoptysis (traces only). X-ray: Both apices opaque and shrunken, heart narrow, drawn to the left. Right lung: Extensive infiltration. Left lung: Infiltration and fibrosis. Clinical (three weeks later): Final diagnosis, chronic pulmonary tuberculosis. Discharged improved. Sent to sanatorium.

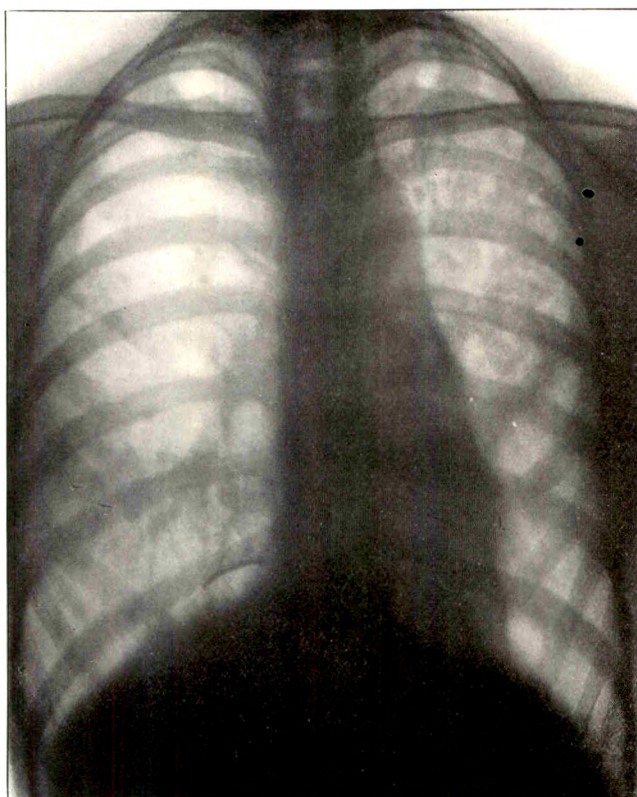


FIG. 2.—Case 5.

CASE 2.—Male. T.B. negative. History: Malaria and dysentery while in Army. Demobilised; later hæmoptysis (excessive) on two occasions. X-ray: Mediastinum drawn slightly to the right. Right chest: Apex of lung opaque and mottled. Infiltration and fibrosis of right lung. Left chest: Compensatory emphysema of lung; much linear striation, and some suspicious scattered mottling. Clinical (two weeks later): Fine crepitations under right clavicle. T.B. positive. Complement fixation test positive.

CASE 3.—Male, aged 40. T.B. negative. History: 1900-1905, in Army; 1905, malaria, occasional slight cough; 1909, debilitated; 1918, onset of cough; 1919, cough worse, suspicious larynx; never pneumonia, pleurisy, influenza or bronchitis. X-ray: Lessened translucency of both apices (right more than left); general infiltration of both lungs; heart narrow and vertical. Clinical (three weeks later): A few T.B. found. Complement fixation test negative. Slight pyrexia. Later: Diffuse infiltration of both lungs.

CASE 4.—Female, aged 38. T.B. positive. History: No history of pneumonia or pleurisy. 1919: Influenza, cough, anorexia. No hæmoptysis. Pain in left base. X-ray: Fixation of left side of diaphragm. Heart drawn slightly to the left. Infiltration of both lungs. (?) Excavation of the left lower lobe. Clinical (later): Chronic pulmonary tuberculosis (? primary basal). Excavation left lower lobe.

CASE 5.—Female, aged 27, single. T.B. negative four times. History: Rheumatic fever. 1920: Influenza; winter cough for five or six years. 1921: Hæmoptysis. X-ray: Right lung; emphysema; infiltration; fibrosis, chiefly middle and lower lobes. Left lung: Apical infiltration. Heart narrow and vertical. Clinical (one month later): A few crepitations at left apex. Later: Crepitations at both apices. Complement fixation test positive.

CASE 6.—Male, aged 45. T.B. positive. History: Measles and pertussis. Cough fifteen

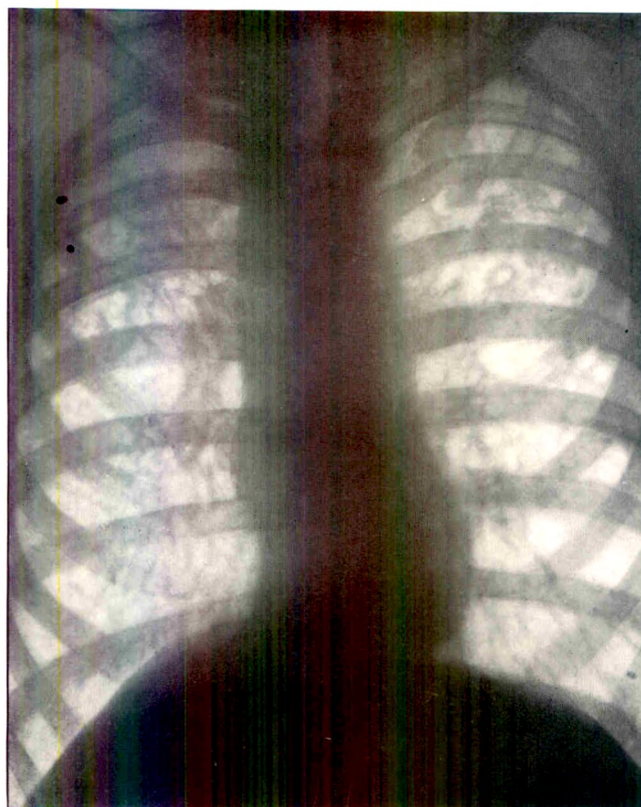


FIG. 3.—Case 6.

months; lassitude and loss of weight. Prisoner of war in Germany. Suffered from septic arm in consequence of a blow on the arm by a German. X-ray: Heart narrow and vertical. Apices of both lungs opaque. Extensive infiltration of both lungs, and evidence of early excavation of right upper lobe. Clinical: Pulmonary tuberculosis both apices.

CASE 7.—Male, aged 20, single. T.B. negative. History: 1919-21, in Army. 1919: Onset of cough. 1920: Cough returned with bronchitis. 1921: Anorexia and loss of weight with some evening pyrexia. T.B. found. X-ray: Heart narrow and vertical. Expansion and translucency lessened at both apices. Infiltration and fibrosis of both upper lobes. Clinical (one month later): Diminished air entry at right apex. Later: Crepitations at both apices. Apyrexial. Final diagnosis: Chronic pulmonary tuberculosis (right more than left).

CASE 8.—Female, aged 23, single. T.B. negative. History: Cough, three weeks. No expectoration; temperature, 99.4° ; weight, 7 st., 5 lb. Family history: one brother alive,

pulmonary tuberculosis. One sister died, pulmonary tuberculosis. X-ray: Heart drawn to the left, and left border ill-defined. Left side of diaphragm raised and movement restricted. Dense, irregular opacity at left base suggesting fibrosis and excavation. Clinical (some weeks later): T.B. positive. Chronic pulmonary tuberculosis, right and left (excavation left base). Died two months later.

CASE 9.—Male, aged 38. T.B. negative. History: Pain under ribs. Morning cough: Expectoration plus, hæmoptysis streaks, loss of weight. Family history: Nothing known. X-ray: Emphysema and some shrinkage of apices. Heavy hilar shadows. Central infiltration of both lungs. Right lung: Interlobar consolidation. Clinical (final diagnosis): Chronic pulmonary tuberculosis both lungs. T.B. positive. Death.

I think one of the primary objects of our discussions here is to talk over our difficulties. Our position in the medical world and with our medical and surgical colleagues is a very different thing to what it was when many of us present began the uphill work of radiography, thanks chiefly to the strenuous work of many whose names are now household names among us. But we are not near our goal, and from time to time there are whisperings that we do not give all the assistance of which we are capable and which is expected of us; that the interest of the patient may better be served by the consultant becoming his own radiologist. I do not wish to labour the point except to say this much, that I think the consulting physician or surgeon who goes outside his province in this way, loses a subtle something of respect, fails in that fineness of outlook and judicial function, with which, possibly in an old-fashioned way, one has always invested him. Those of us who are conversant with the work of the law courts know well the analogy of the judge who is also the advocate.

With regard, however, to the question of the diagnosis of pulmonary disease, I think it is up to us to consider the position. Interpretation of the shadows in a skiagram of the lung is not so easy as is generally supposed, and I venture to say that all of us are tempted to read more into a skiagram than is justifiable. For instance, we are inclined to confuse peri-bronchial fibrosis with the true fibrosis affecting the lung tissue. It is true that in this respect we are at somewhat of a disadvantage, for usually we are asked to commit our opinion to writing after a single examination. I emphasise this difficulty, but it does not get rid of the feeling of doubt, of which we are all conscious, that the clinician may feel that we are not assisting in diagnosis as we ought. If anyone doubts the accuracy of such a statement, I would refer him to the one skiagram reproduced in Sir James Kingston Fowler's book on "Pulmonary Tuberculosis." In this reproduction not one of the classical X-ray evidences is present, and yet upon this case one of us has written a positive diagnosis of chronic pulmonary tuberculosis, and has kindly but definitely been given a rap over the knuckles by the writer of the book in question.

I have referred to the possibility of the clinician becoming his own radiologist. My hope is that the future may see the radiologist so highly trained and the clinician so keen on team work as to make so retrograde a step not only unnecessary but impossible.

SOME EFFECTS OF EXPOSURE TO RADIUM UPON THE ALIMENTARY CANAL.

By J. C. MOTTRAM, M.B.

From the Research Department, Radium Institute, London.

Reprinted, with permission, from "The Proceedings of the Royal Society of Medicine, Sect. Elec.," May, 1923.

It has been recently observed that exposure of dogs to large doses of X rays quickly produces desquamation and necrosis of the intestinal mucosa (1). Barlow exposed various animals to the gamma radiation from 5 grm. of radium, and found, as an early change, desquamation of the intestinal mucosa, and mucoid degeneration in the case of the colon and rectum (2).

The following observations have been made to discover what are the first histological changes in the alimentary canal, and at what period after radiation they occur, with a view to seeing whether they could in any way account for some of the late effects of exposure to radium, for instance, the thrombopænia and anaemia.

Six rats were exposed continuously to 220 mgr. $\text{RaBr}_2 \cdot 2\text{H}_2\text{O}$, distance 8 in., screen 0.1 mm. lead plus 0.12 silver. They were killed with gas after periods of one, two, three, four, five and six days exposure. Six similar non-irradiated rats served as controls. All histological procedure was carried out in duplicate.

The following tissues were examined: Stomach (cardiac and pyloric portions), small intestine at distances of 5 in., 10 in., 15 in., 20 in. from the stomach, caecum, and colon at distance of 2 in. from caecum.

Numerous staining methods were used, more especially Van Gieson—Nile blue for bacteria and carbol-thionin with iodine for mucus.

The changes in the caecum are first described. In this region of the alimentary canal the mucosa consists of a single layer of columnar cells, everywhere pitted with short mucous glands, which project into a loose connective tissue. No deviations from the normal were observed after twenty-four hours exposure. The first changes were found after forty-eight hours, and consisted in a very great increase of mucinogen granules in the cells lining the tubular glands, the granules occupying clear vacuoles in the cell protoplasm. This granule formation and vacuolation occurs in the normal goblet cell, and is the first stage in the formation of mucus. In the radiated specimens it is, however, not confined to goblet cells, but columnar cells also show the change; moreover, it occurs in an extensive and disorderly manner. It may be described as the first stage of a mucoid degeneration rather than the exacerbation of the normal production of mucus.

After three days the granular degeneration is still present, with the difference that the granules tend to be larger and less numerous, and the hyaline material more abundant. Normal goblet cells are rarely seen except in the discharged condition. The mucoid degeneration involves the cells at the base of the

glands, where goblet cells are not usually seen, so that a striking difference is now found between experiments and controls.

After four days exposure very few mucinogen granules are seen. Normal goblet cells are not now to be found. The mucous material in the radiated specimen stains much less strongly pink with thionin than normal goblet cells. Except at the base of the gland there is now no mucus occupying the lumen of the gland, or plugging its mouth.

Apart from this mucoid degeneration no other histological changes were seen, except that the columnar cells stained somewhat more faintly than the normals and their nuclei were larger and less deeply stained. Mitotic figures were as numerous in the experimentals as in the controls.

In the fifth and sixth day specimens little further change occurs: no further mucus is produced, and that which is found at the base of the glands stains only faintly pink with thionin. Small areas of desquamation of the columnar cells, leaving bare the connective tissue, were occasionally observed.

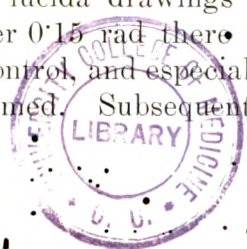
The changes in the colon were identical with those in the cæcum, except that in the fifth and sixth day specimens no mucus staining material was found, the gland being filled with a hyaline material which did not stain pink with thionin, nor brown with iodine, so that this degeneration may be described as pseudo-mucoid rather than mucoid.

In the small intestine similar changes occur wherever mucoid-producing tissues occur. The mucous glands of Lieberkühn are especially involved, and here the mucosa between the villi tends to become desquamated. In the stomach no changes were observed; neither in the pyloric nor cardiac portions do mucoid glands occur.

One other change was observed: in the case of the cæcum and colon in the fifth and sixth day specimens the intestinal contents were found post-mortem to be closely adherent to the mucosa, whereas in the controls they were very easily separated. This change was also seen in the histological specimens; in the experimental specimens of the fifth and sixth day bacteria were found everywhere closely adherent to the mucosa, and in many places invading the epithelial cells and the connective tissue beneath. Protozoa (*trichomonas*) were also found invading the cells of the mucosa in the radiated specimens.

Summarising these findings, it may be said that at first there is an excessive production of mucus in an abnormal manner, a mucoid degeneration, and later a stoppage of mucus production, accompanied by a pseudo-mucoid degeneration of the cells. The absence of mucus allows the bacteria of the colon and cæcum to come into intimate contact with the mucosa, and this is followed by a bacterial invasion of the epithelium and connective tissues.

The diagrams reproduced (see Figs. 1-4) illustrate the changes in mucus production of the cæcum. They are low-power camera lucida drawings of specimens stained with iodine and thionine blue. After 0.15 rad there is, as shown, an increased production as compared with the control, and especially at the bases of the glands, where normally mucus is not formed. Subsequently



the mucus production ceases, so that after 0.4 rad only a little mucus is to be seen at the base of the glands.

The question as to whether these effects of exposure to radium can in any

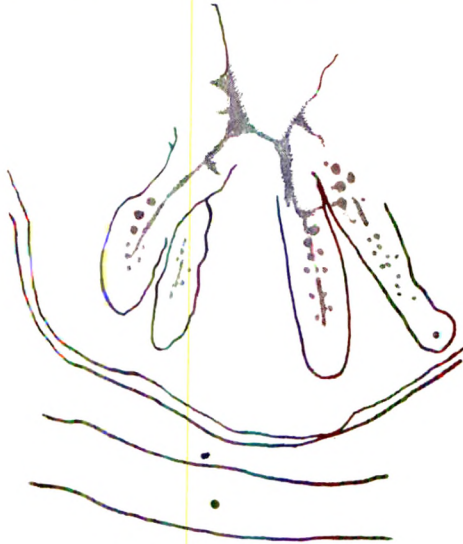


FIG. 1.—Control.

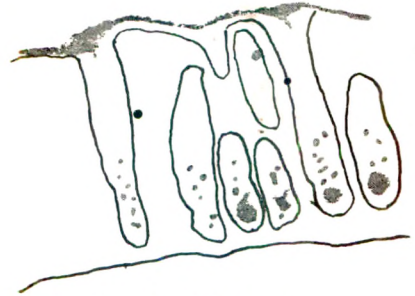


FIG. 2.—0.15 rads.

way account for the thrombopenia and anæmia which occur later may now be considered.

The thrombopenia begins under the same conditions of exposure on the fourth and fifth day, but is not profound until the tenth or twelfth day (3), so that its beginning corresponds in respect of time with the bacterial invasion of the mucosa. Now it is known that the introduction of bacteria into the



FIG. 3.—0.25 rads.



FIG. 4.—0.4 rads.

circulation causes a profound thrombopenia, so that it may well be that this change in the mucosa may condition the thrombopenia. On the other hand, the fact that radiation produces a rise as well as a fall in platelets suggests that it may be the primary cause in both cases. As regards the anæmia, this

occurs a little later, and may also be due to invasion of the blood stream by bacteria from the alimentary tract; though Moller (4) is of opinion that the anæmia is the result of hæmorrhages resulting from the profound thrombopænia which follows radiation; on the other hand, there is evidence that infection may be an important factor (3). The necrosis and desquamation of the villi in the small intestine found by Barlow (2) after large doses of radium, and by Warren and Whipple (1) after large doses of X-radiation, follows the bacterial invasion of the mucosa, and is probably due to this infection.

These findings show that the normal production of mucus in the alimentary tract is interfered with by very small doses of radiation, less than would be required, for instance, to effect histological changes in the testes or skin. It follows that when treating patients with large doses of radiation care should be taken to expose the alimentary canal, and especially the lower portions, as little as possible. This may also apply to the nasal passages, trachea and bronchi, and in fact wherever mucus is secreted. The symptoms which are likely to occur if efficient protection is not given are mucoïd diarrhœa, general symptoms of toxæmia from absorption of intestinal bacteria, and later blood changes such as thrombopænia and anæmia, due to a bacterial invasion of the blood.

The radium used in this investigation was on loan from the Medical Research Council.

REFERENCES.

- (1) Warren and Whipple, *Journ. Exper. Med.*, 1922, Vol. XXXV, p. 187.
- (2) Barlow, "Medical Research Council Reports," No. 62.
- (3) Cramer, Drew and Mottram, *Proc. Royal Soc., B.*, 1922, Vol. XCIII, p. 449.
- (4) Moller, *Compt. rend. Soc. de Biol.*, 1922, Vol. LXXXVII, p. 759.

NOTES AND ABSTRACTS.

Report of a Case of Myositis Ossificans Progressiva with Bibliography.—J. J. NUTT (*Jour. Bone and Joint Surg.*, April, 1923, p. 344).—The case reported was that of a boy, æt. 10 years. The following muscles were involved: the masseters, fixing the inferior mandibular articulation so that only half an inch separation of the incisors could be obtained; both sterno-mastoids, trapezius latissimus dorsi, external oblique abdominalis of the right side, both pectoral muscles; the pectoralis major muscle on each side was changed into an almost solid plate of bone.

The adductors of the right leg were ossified throughout their length.

The Wassermann reaction was negative. Blood analysis showed decrease in the calcium content.

Myositis ossificans progressiva is a disease of early life, in which the fibrous tissue in and about the muscles is converted into bone. It steadily progresses, and may eventually render the subject a veritable ossified man. No therapeutic measure is known to retard its progress.

C. P. G. W.

The Value of the Roentgen Ray in the Diagnosis and Prognosis of Sarcoma of the Long Bones.—HENRY W. MEYERDING (*Jour. Bone and Joint Surg.*, April, 1923, p. 323).—Meyerding maintains that a good skiagram is one of the most valuable, if not the most valuable, aid in the diagnosis and prognosis of sarcoma of the long bones. It reveals the location, size and extent, and to a certain degree, the structure and origin of the tumour and the presence of secondary deposits.

It is the earliest aid in determining the presence of pulmonary metastasis, although the absence of demonstrable lesions does not mean that metastasis have not occurred.

Meyerding is of the opinion that skiagrams of the lungs should be made as a routine measure in every case of suspected malignant tumour of the long bones, particularly if surgery is contemplated for removal of the primary tumour.

C. P. G. W.

PUBLICATIONS RECEIVED.

Journals.

Acta Radiologica, Vol. XI, Fasc. 2.

Archives d'Electricité Médicale et de Physiothérapie, May, 1923.

Archives de Médecine et de Pharmacie, January, 1923.

British Journal of Dermatology and Syphilis, June, 1923.

Bulletin et Memoires de la Société de Radiologie Médicale de France, May, 1923.

Hospitaltidende, May 16th, 23rd, 30th; June 6th, 1923.

International Journal of Orthodontia, Oral Surgery and Radiography, May, 1923.

Journal de Médecine de Bordeaux, May 25th; June 10th, 1923.

Journals—continued.

Journal de Médecine de Lyon, May 20th; June 5th, 1923.

Journal de Radiologie et d'Electrologie, May, 1923.

Kongresszentralblatt für die Gesamte Innere Medizin, May 28th; June 4th, 11th, 1923.

La Radiologia Medica, June, 1923.

Medical Journal of Australia, April 14th, 21st, 28th; May 5th, 12th, 1923.

New York Medical Journal, June 6th, 1923.

Il Policlinico, May 15th, 1923.

Surgery, Gynecology, and Obstetrics, June, 1923.

Urologic and Cutaneous Review, June, 1923.

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THE MACKENZIE DAVIDSON MEMORIAL LECTURE.

DELIVERED AT THE FIRST ANNUAL JOINT MEETING OF THE RÖNTGEN SOCIETY AND THE ELECTROTHERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE, MAY 17th, 1923.

By Professor ARIAL W. GEORGE, M.D.

Assistant Professor of Roentgenology, Tuft's College, Boston, Mass.

It was with distinct pleasure that I accepted your invitation to come to England, to talk to you on this most interesting subject. And further, the knowledge that this meeting commemorates the memory of one who sacrificed his life in the advancement of our speciality makes me feel humbly grateful for the honour you have extended to me and America. I refer to Sir James Mackenzie Davidson, whose work was so well known in my country and throughout the world. The pleasure is enhanced by the opportunity it gives me of meeting so many radiologists whom we have heard about and whose works we have read during the past years. The name of Robert Knox is as familiar to the American roentgenologists as any one of our own; that of Thurstan Holland, Barclay, Morton, and Jordan, and many other of our English colleagues, are very familiar to all in my country. It is our desire, and I have heard it expressed many times before and after the war, that we might have the privilege of meeting in our own country some of our English confrères, whom we would welcome in a body or individually at our clinics,

and above all at our annual meetings of the Roentgen societies. A combined meeting of the British and American societies in America would go a long way towards cementing that friendship which was begun during the years of war. I sincerely hope that my visit to England may help to further some plans which may eventuate in some such meeting. As president, and in the name of the New England Roentgen Society, I extend to you all a cordial invitation to visit America, and in the name of the Society I extend to you the cordial greetings of the members.

It is my belief that the English speaking people lead, and should continue to show the way in the practice of our speciality. We possess the brains, our scientific research workers are energetically promoting investigations on the problems of radiology; with their help and with the abundant energy which characterises our race we should be able to take a leading place in all future progress.

THE PATHOLOGICAL GALL BLADDER.

No one can approach the gall bladder problem without being familiar with the work of Robert Knox. To Dr. Leonard and myself, his publication on the "Radiography of the Gall Bladder" was probably the greatest stimulus we had in our early work upon gall bladder disease and gall stone diagnosis. Possibly we were a little discouraged after a careful analysis of Knox's work, because of the fact that he showed there existed a large group of gall stones which, with existing technique, could not be demonstrated by X rays, owing largely to the physical properties of those gall stones.

In the early days of our gastro-intestinal work, when studying the duodenum by the plate method, so ably advocated by Cole of New York, we occasionally found shadows either distinctly due to gall stones or very suggestive of such a condition. We spent a great deal of time, study and effort, to determine, in every case which came to our notice in our clinic, whether gall stones were present, and if they were found to distinguish between those which were readily recognised and those which were more difficult to distinguish. After achieving considerably more success than we had ventured to hope for in the beginning, we found that there were many cases showing indefinite shadows, suggestive, so far as size, position and shape went, yet hardly diagnostic of gall stones. In addition to those fairly indefinite points there was a certain amount of increase in the density, sufficiently marked to raise the question whether those shadows might not be due to a collection of gall stones in the gall bladder. After a period of time, during which we met with discouragement from many quarters, and especially from a number of our colleagues, it was gradually forced upon us, that in a good many cases in which we thought, because of the density and the shape of the shadows, that we were dealing with gall stones, in which on operation the gall bladder did not contain stones, that the shadows shown might be due to the gall bladder itself, and that the organ was rendered visible by changes in the gall bladder or its contents, viz., chronic thickening of the walls, inspissated bile or very thick and dark bile.

We accordingly changed our opinion on the question of gall stone diagnosis, and in our reports on cases examined altered our description and referred to the condition as "The Pathological Gall Bladder." Our interest became centred on this aspect of our work, and it became obvious from previous experience in gastro-intestinal work, and more especially from observations on the right upper quadrant of the abdomen, that we had not been able up to that period to demonstrate the normal gall bladder, and we believe that the statement holds good to-day. There may be an occasional exception to this rule, when the normal healthy gall bladder is shown, but speaking generally, it may be asserted with safety that, as a rule, in the great majority of cases we are unable to demonstrate the normal healthy gall bladder. With this conviction in our minds, we began to recognise a shadow in the right upper quadrant, consistent in size, shape and position with what we conceived the gall bladder to resemble, and therefore in all probability the gall bladder itself rendered visible on the negative. We concluded that what was shown was the gall bladder, and that its visualisation was rendered possible by some change within itself. This we regarded as the pathological gall bladder with or without gall stones. Again, we found that our colleagues did not take kindly to this observation, their efforts, aided by most of the roentgenologists, were directed to prove that the normal gall bladder could be demonstrated, and therefore that our deductions were erroneous. For a time we, in the work of our clinic, stood alone in the field of pathological gall bladder diagnosis; however, within the last few months there has been a change of opinion, and others are beginning to share our views on the subject. This rapid change was particularly brought about by one of the younger radiologists, Kirkland, of Muncie, Indiana, who was associated with me in the army and became interested in this branch of our speciality. On his return to civil practice he was fortunately located in a state and in a part of our country in which gall stones and biliary disease appeared to be comparatively common, in people of an age rendering them susceptible to those conditions. Within a year or two he made a collection almost equal to ours in number. He carried on the work on lines similar to our own, and, studying the cases from the same points of view, he obtained comparable results from the X-ray point of view. He was fortunate enough to have the surgical findings in agreement with his X-ray diagnosis in a large percentage of the cases examined. As an outcome of this he was invited to the Mayo clinic for two months, and during that time he examined by X rays the gall bladder cases investigated at the clinic, diagnosed clinically as gall stone or gall bladder cases and prepared for operation. I have not his exact figures, but I believe that in 92 per cent. of the cases he examined the diagnosis of gall stones or gall bladder disease was found to be correct. The total number examined was over 100. This appears to me to be a very startling, but satisfactory demonstration of the ability of a trained observer, following a comprehensive technique, to prove the value of the method. I cannot personally speak too highly of my appreciation of Dr. Kirkland's work.

Later, as we perfected the technique of the examination of the upper right quadrant, there came a time when we needed, in a large number of cases, other evidence to help substantiate the visible gall bladder, so we began to enumerate and classify observations which we called "indirect evidence" or "secondary evidence." We prefer the latter term.

PRESSURE DEFORMITY.

We found that the normal healthy gall bladder did not cause pressure so that it would outline itself upon the barium mass. We also found, however, that when we obtained this pressure deformity of a certain character it was almost conclusively due to the gall bladder, and in almost every instance to disease of the gall bladder—in other words, we were dealing with a pathological gall bladder.

We classify this filling defect, or pressure deformity, in various ways. The effect of the gall bladder pressure is exercised upon the first portion of the duodenum, in both the antero-posterior and lateral diameters. We may find in the gastro-intestinal examinations deformity of the first portion of the duodenum due to various causes, such as poor filling of the cap at the moment of exposure, malposition of the stomach for various reasons, either normal or abnormal, spasm at the pylorus, adhesions, and ulcer. I believe that most of us can recognise the characteristic changes of ulcer as easily as cancer of the stomach. There may be unusual deformities, sometimes hard to differentiate from ulcer, but we have our method of determining these with more or less of a certainty.

In the deformity due to a gall bladder we have a definite and tangible shadow, which we have termed a "half-shadow," due to the convex or rounded surface of the gall bladder pressing against the corresponding surface of the duodenum. To make this important point clear, we assume that the pathological gall bladder possesses a positive pressure from the contents, either gall stones or altered bile. The distended gall bladder becomes spherical, and any part of its contour will be more or less convex. If the pressure is sufficiently great it will make an impression upon the corresponding surface of the duodenum, and when the opaque material fills the "cap" it is unable to overcome the pressure exercised by the gall bladder, and a concave depression will appear at the part in apposition with the gall bladder. If the edge of the liver, which is a flat surface as a rule, presses against the duodenum, we lack the "half-shadow," as we have no concavity to produce this half-shadow. My own colleagues in America have not seemed to grasp the fundamentals of pressure deformity due to the gall bladder; i.e., the interpretation or differentiation of a pressure deformity due to a gall bladder in contradistinction to that of a liver, edge *must* be understood and recognised, to make what I am going to say clear and easy for interpretation.

CAUSATION OF PRESSURE.

Why should the gall bladder cause this pressure? In the first place, we have pathological gall bladders with no adhesions, and a great many with adhesions between the gall bladder and the duodenum. The chances are that at some period of the examination or examinations there will be tension within a pathological gall bladder greater than the tension within the duodenum when filled with barium. We conclude that when the stomach is in either the prone or lateral position it cannot, in view of the power exerted by gravity, peristalsis, and the weight of the barium mass, push to one side a gall bladder in close approximation to the duodenum; we then have the feeling that tension is greater in the gall bladder than in the duodenum. We admit that occasionally one finds a perfectly healthy gall bladder which for a short period of time is under tension, but which empties itself sooner or later. On the other hand, a gall bladder under tension with power to impose itself upon the first portion of the duodenum is potentially pathological in some degree.

Unfortunately, we must admit that under ordinary circumstances fluoroscopy does not help to determine these facts; the latter can only be obtained with the most careful plate or film method. Many cases show deformity not in the prone position, but only in the lateral position, so that all views must be taken. Many cases show the pressure deformity of the gall bladder upon the first portion of the duodenum in the lateral position, but they more frequently show the picking up of the second portion of the duodenum and its extension back toward the spine in the horizontal position. It is therefore important, when one suspects a deformity due to a distended pathological gall bladder, to in every way possible endeavour to demonstrate the half-shadow effect, because this is in our opinion peculiar to the deformity caused by the convex body of the gall bladder. With gall stones of the type invisible to X rays we occasionally see a serrated edge to the shadow produced by the gall bladder against the duodenum.

I have no statistics as to the relative frequency of pressure deformity and pathological gall bladder, but Dr. Leonard and I feel more convinced to-day than ever that this deformity is one of our strongest links in the chain of evidence toward the diagnosis of a pathological gall bladder.

INVOLVEMENT OF SECOND PORTION OF THE DUODENUM.

The second important structure involved—although perhaps not so frequently as the first portion of the duodenum—is the second portion. Those who have carried out one method of procedure, covering a large series of cases and over a long period of time, realise the appearance of the average normal stomach. In the prone position we find that the second portion of the duodenum extends downward parallel to the vertebræ, until it reaches its third portion, where it passes upwards and behind the stomach; the position of the second portion has a great significance in the diagnosis not only of gall bladder disease but of other conditions.

Exceptions are met with in very stout or very poorly nourished patients, or in those with scoliosis or some skeletal defect which gives rise to change in the organs generally; apart from these the position of the second portion of the duodenum is constant, as above outlined; a very common change due to gall bladder disease is the picking up of the second portion of the duodenum outward toward the liver, and in quite a number of cases the size of the gall bladder can be outlined by the position of the second portion of the duodenum. In the study of the pancreas, changes in the second portion form our most important diagnostic sign. In the lateral position, instead of the second portion of the duodenum passing downward and parallel to the vertebræ, it often takes a backward curve, depending upon the size of the head of the pancreas. With a nodular pancreas this pressure deformity of the nodules will be seen on the barium-filled second portion of the duodenum so clearly that there is no great difficulty in the interpretation. Again, in the lateral position, a duodenum that passes backward towards the vertebræ, and then forms an angle passing downward again to its normal position, is most significant of gall bladder disease. Burnham, of San Francisco, at a meeting of the American Roentgen Ray Society in September, 1922, very definitely brought out this observation in a large series of cases.

In dealing with retroperitoneal tumours—for example, sarcoma—the duodenum will be found to be pushed in the opposite direction, and the tumour mass will be outlined upon the posterior portion of the duodenum; it can be detected by the new position which the second portion of the duodenum takes as compared with the normal.

It is, of course, unnecessary to say that the best results will be obtained by the plate or film method; with sufficient experience this observation can be detected fluoroscopically. An exception to general rules is the post-operative case; all the above observations may be valueless because of fixation, omental and otherwise. All cases that have had previous abdominal operation, especially of the upper right quadrant, are difficult to interpret, as normal relations are so definitely disturbed in some instances. We cannot urge too strongly a careful consideration of all these facts relative to gall bladder disease. The second portion of the duodenum plays its most important part in the diagnosis of the gall bladder region.

When the duodenum passes outward toward the liver, and then proceeds downward to its normal position, we must consider that this position of the duodenum is due definitely to fixation, and in only rare exceptions will this be found to be due to other than gall bladder adhesions. When this occurs it is a very definite observation.

PRESSURE UPON THE ANTRUM.

Pressure of the gall bladder upon the antrum of the stomach will occur as frequently as pressure deformity on the first portion of the duodenum; in a large number of cases it will be found on the first portion of the duodenum, extending on to the antrum. In this observation we must look for this half-

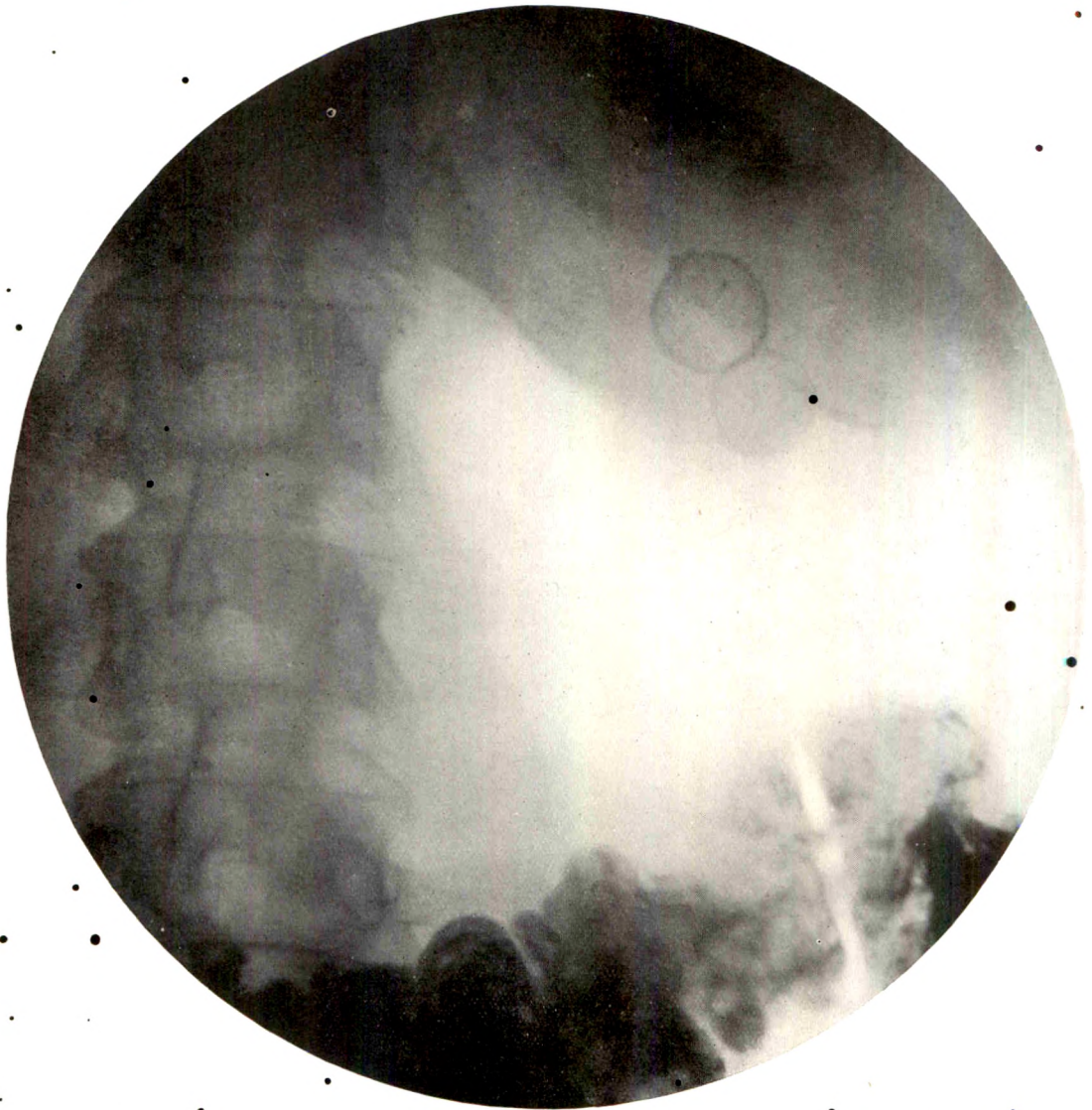


FIG. 1.—Gall stones.

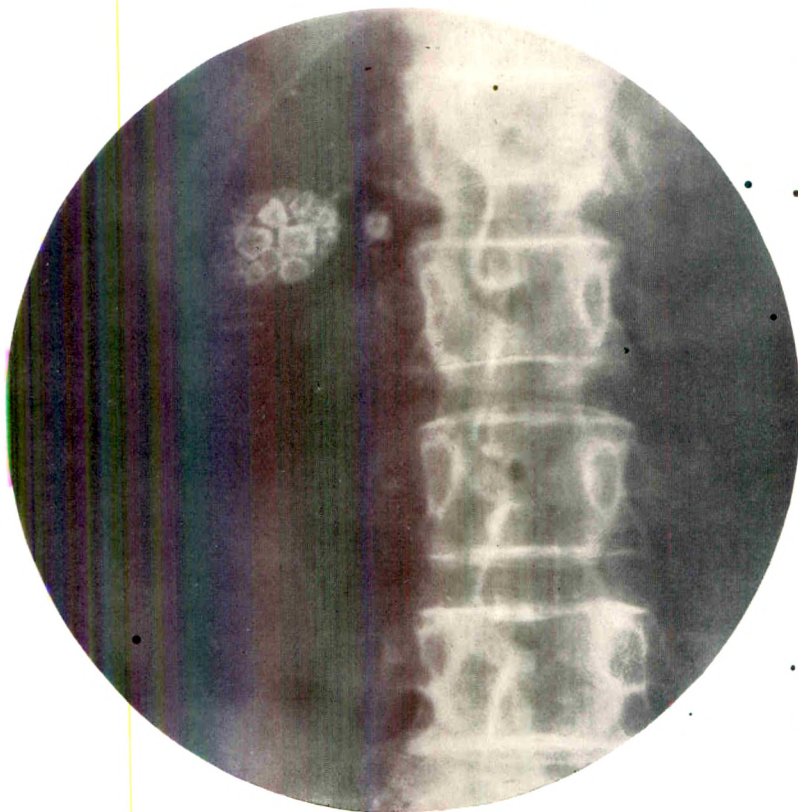


FIG. 2.—Gall stones.

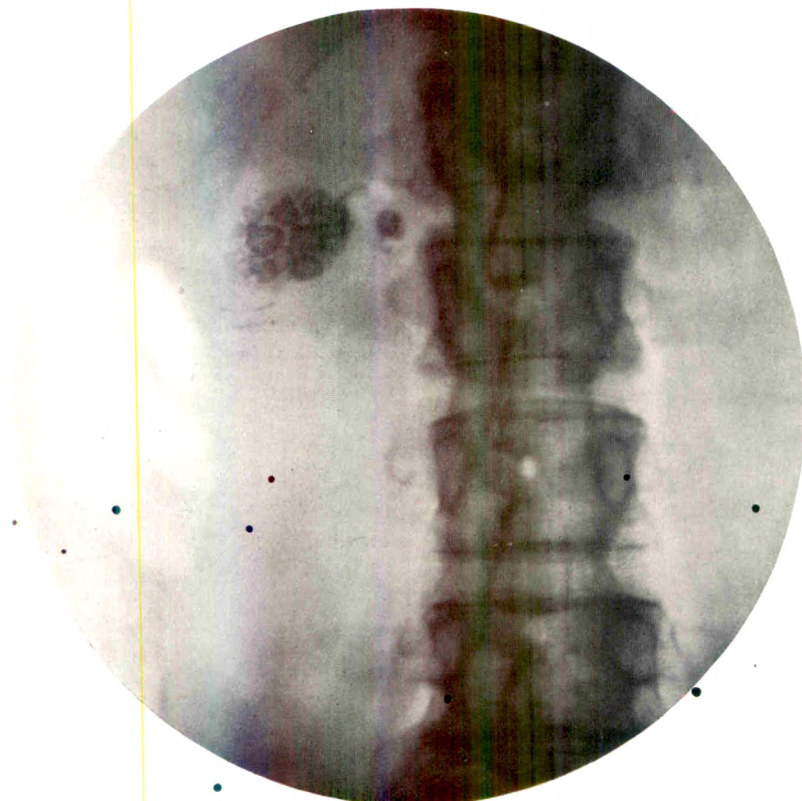


FIG. 3.—Gall stones.

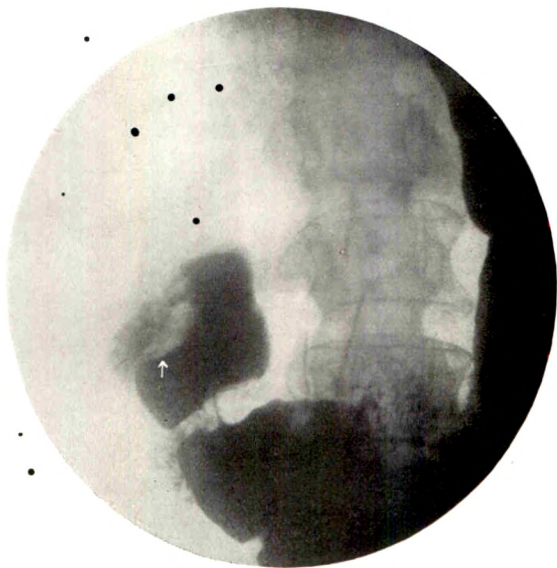


FIG. 4.—Pressure deformity of the duodenal bulb.

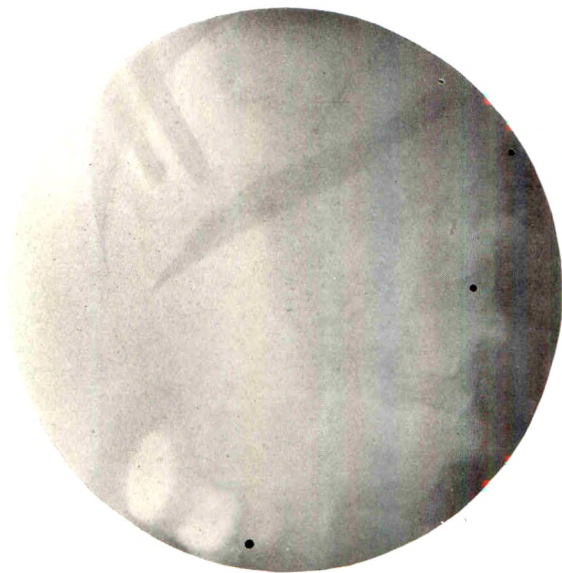


FIG. 5.—Group of small gall stones, very indefinite.

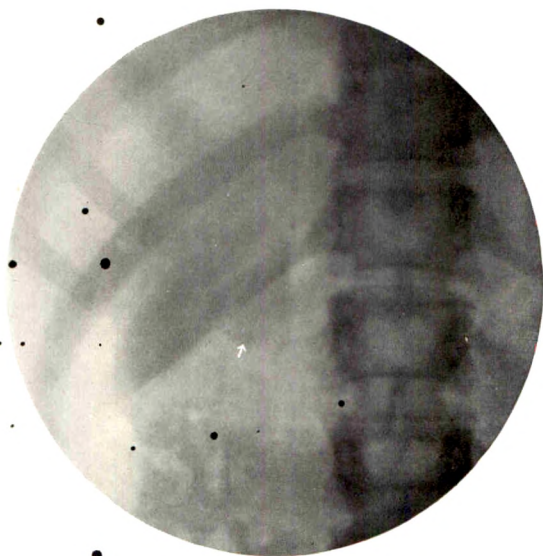


FIG. 6.—Visible gall bladder, without stones.

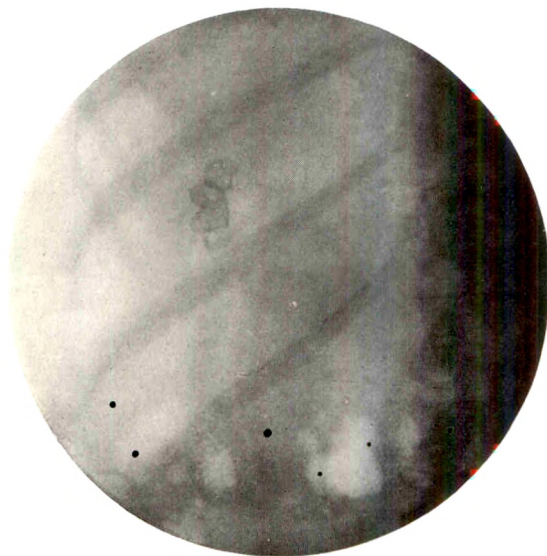


FIG. 7.—Gall stones.

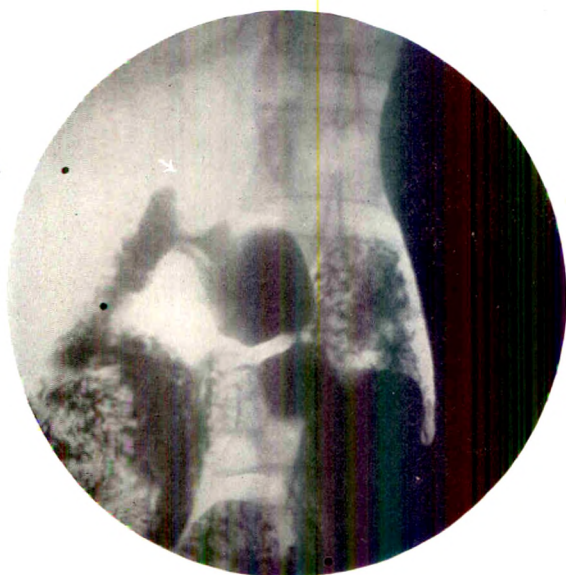


FIG. 8.—F. Constant pressure of pathological gall bladder on second portion of duodenum.

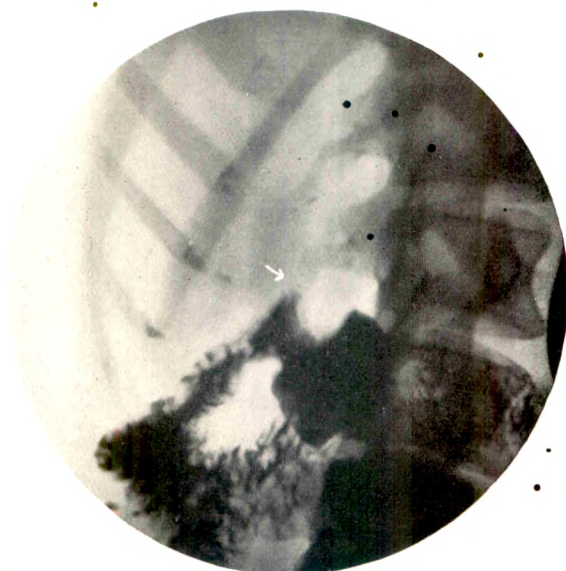


FIG. 9.—Pressure of pathological gall bladder on second portion of duodenum.



FIG. 10.—Fixation of second portion of duodenum due to pathological gall bladder.

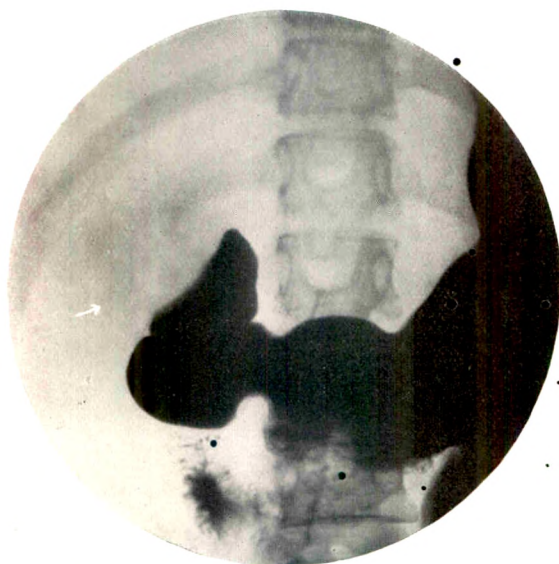


FIG. 11.—G. Constant pressure of pathological gall bladder on first portion of duodenum.

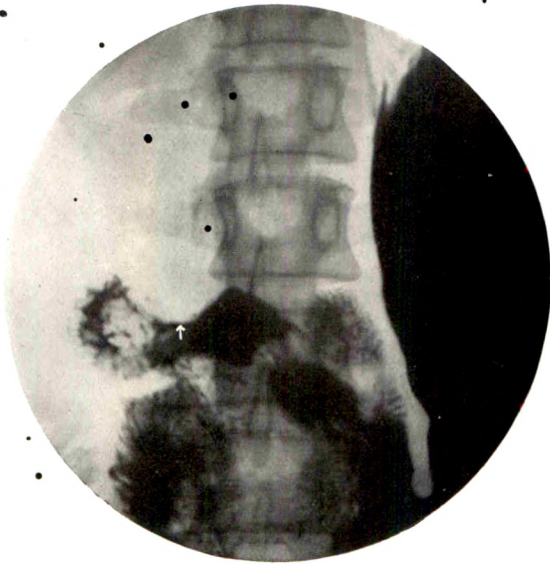


FIG. 12.—Constant pressure on first portion of duodenum, and fixation of second portion of duodenum due to pathological gall bladder.

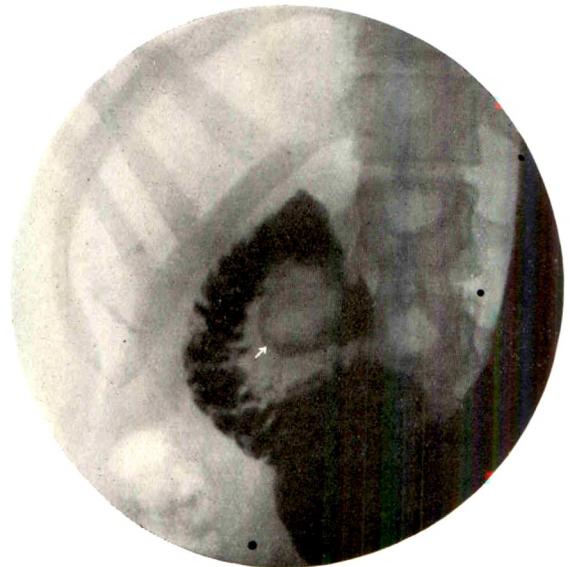


FIG. 13.—Pressure of gall bladder on first portion of duodenum.

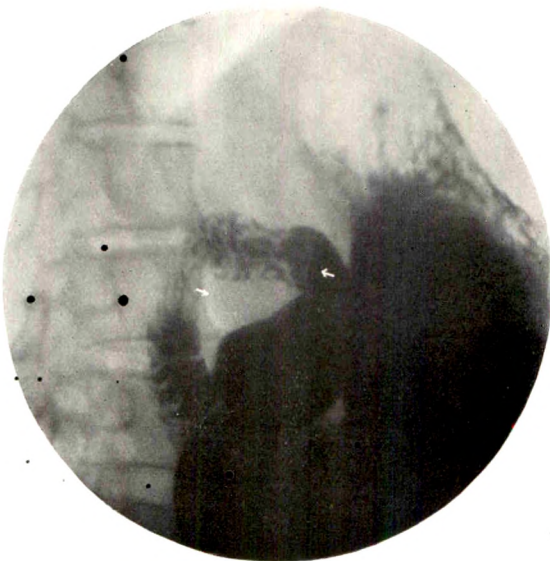


FIG. 14.—Visible pathological gall bladder. Secondary pressure on first and second portions of duodenum and antrum of stomach. (Lateral view.)

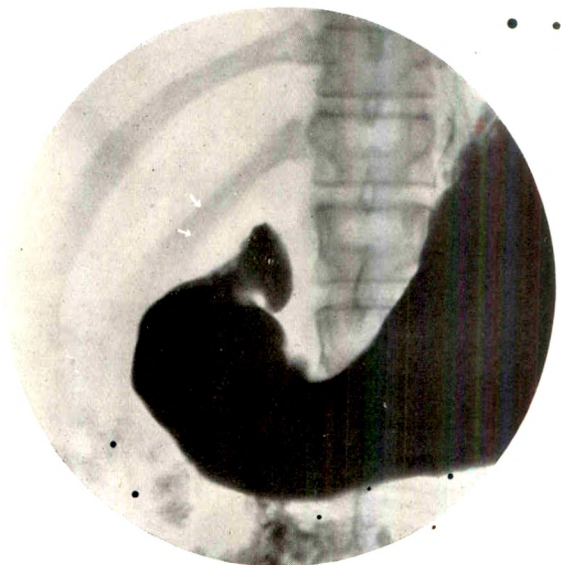


FIG. 15.—Pressure of pathological gall bladder, containing stones on antrum of stomach.

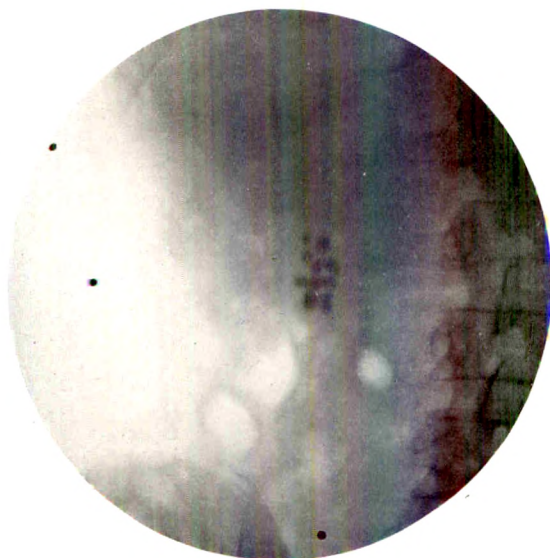


FIG. 16.—Multiple small gall stones.

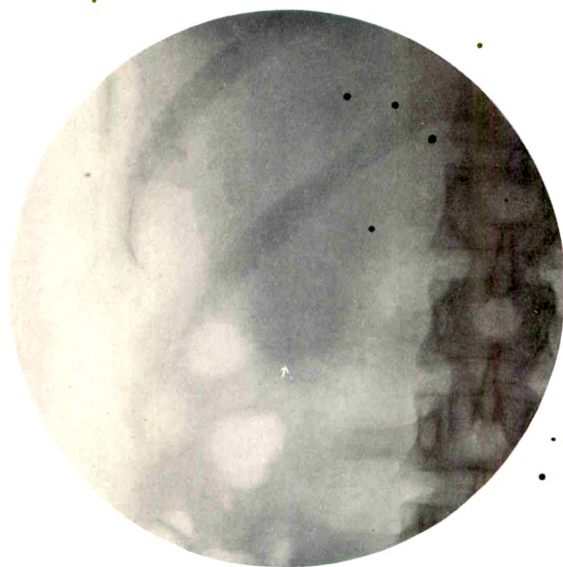


FIG. 17.—Large gall bladder with stones.

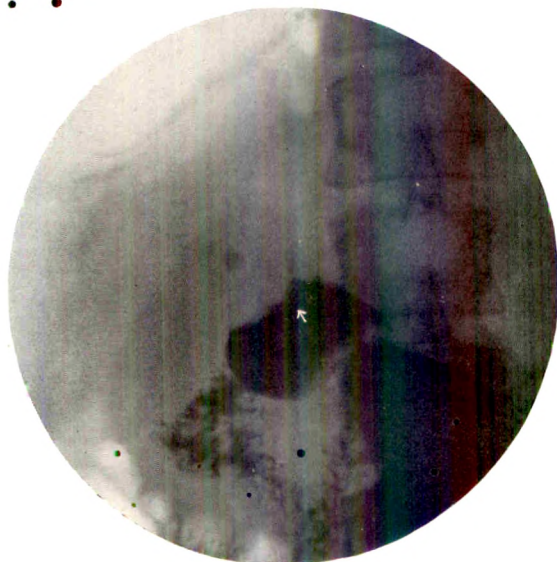


FIG. 18.—One stone and pressure of gall bladder on first portion of duodenum.

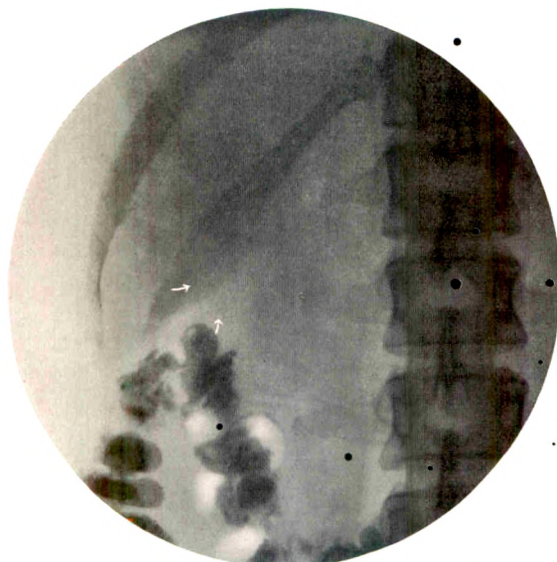


FIG. 19.—Gall stones.

shadow effect. Another observation of value is the transposition of the jejunum from its normal position from the left to the upper right quadrant. This has frequently been of assistance to us in the determination of gall bladder disease; but we appreciate from experience that tuberculous or other peritonitis earlier in life may be the cause. It is remarkable how easily the gall bladder throws out adhesions and picks up adjacent structures.

FILLING OF THE AMPULLA OF VATER.

A fourth observation of relatively common occurrence, but possibly not of quite such definite value, is the filling of the ampulla of Vater. We have found, in every instance in which we have had the cases operated upon, that if we could show the ampulla full of barium throughout a series of gastrointestinal plates or films, this was significant of one of two conditions—gall bladder disease or disease of the pancreas. We know, of course, changes frequently occur in the pancreas secondary to chronic gall bladder disease. At one time we kept a record of a series of these visible ampulla cases operated upon for gall bladder disease and other conditions to the number of twenty-seven; in every instance they displayed disease either of the gall bladder or of the pancreas, or both. If all the other indications outlined are absent or cannot be demonstrated, and if we find only the filling of the ampulla of Vater, we feel that we have neglected for one reason or another to obtain the most satisfactory results from this method throughout the examination.

CHANGE IN POSITION OF PROXIMAL PORTION OF TRANSVERSE COLON.

Another observation that can be mentioned, and which is of considerable importance, is the change in position of the proximal portion of the transverse colon. In a way it forms a secondary hepatic flexure, or, as we have sometimes called it, a "pseudo-hepatic flexure." Very often, in the absence of all other signs, this change of the transverse colon will be present and will constitute the *only diagnostic* sign pointing to the gall bladder.

One other diagnostic factor, brought forward by Carman, Burnham, and others, which we have felt was not entirely reliable, is so-called spasm which occurs in the antrum of the stomach. Possibly this should be observed with the fluoroscope rather than with plates or films; we do not attach any considerable significance to it, unless it appears in conjunction with other signs which makes the diagnosis positive.

It can be readily seen that if these observations which I have enumerated are reliable, we have considerable evidence to help towards the diagnosis of a pathological gall bladder or stones, aside from the visible gall bladder. To me this makes the work still more satisfactory, because we are not depending upon one diagnostic observation, but upon numerous ones, any one of which may be of the utmost importance in a given case.

NEGATIVE VALUE OF X RAYS.

Many have asked the question, "What is the negative value of X rays?" We feel, perhaps now more strongly than ever, that if we have evidence which makes for a *positive diagnosis*, then the absence of all of this evidence has some value towards the negative aspect of the study. We are sure that with a proper examination, a given case of actual pathological processes of the gall bladder can be in almost every instance recognised by changes manifested in the plate or film of the X-ray examination. There are unquestionably degrees of pathological processes, such as mild cholecystitis, which do not change the quality of the bile to any extent or give rise to thickening of the bladder wall. I do believe that even in these cases we can, with careful films, bring out secondary evidence of diagnostic importance. Even with cholesterin stones, which are usually in numbers, if we have a large number we have mass, and if we have mass we have increased density. It may not always be possible to recognise individual stones, but with increased density and the shape of the gall bladder we can be pretty sure that we are dealing with a chronic gall bladder, or with stones, or both.

The question is then asked as follows: "Why, when we have simply the microscopic change in the gall bladder wall, can we detect these changes with X rays?" So far as our experience is concerned, and so far as we can find from the literature, the moment infection takes place in the gall bladder there is change in the tissue of the gall bladder, and immediately, or very soon, the bile becomes turbid, cloudy, considerably darker, and more tar-like. We found in a series of laboratory tests that this bile, as it darkens in colour from the normal, becomes denser in quality, with increase of opacity. We have had gall bladders removed, and with an immediate specific gravity test of the bile found it was double the normal. It is perfectly obvious that with this increase in density, or specific gravity, this condition is more easily recognisable with X rays.

PERSEVERANCE NECESSARY.

We have been asked many times by our colleagues, especially of the younger group, why we can show things so constantly when they are unable to do so with the same apparatus and with the same type of people. Perhaps that question can be answered by stating that one big factor in gall bladder work, aside from the necessary apparatus and facilities, is perseverance. The investigator should continue his work in an individual case until he has obtained, through a series of films, a most satisfactory negative from every point of view. This means that the patient must be absolutely at rest without breathing. The technique, the quality, and the exposure value must be exact for the individual case; for this there is no standard. The second big factor in this study seems to me to be a willingness to look for and to admit that these changes exist and can be found.

I think that, in view of our experience covering a number of years and a

large series of cases, we have in the use of X rays a very definite method of examination of the upper right quadrant. If we do not reach 100 per cent. of correct diagnoses, this does not relegate the method to a second place, for our percentages are as high as can be expected in any branch of medical science. Up to the present time no one method touches perfection, but our endeavour should be to make our practice in this speciality as near 100 per cent. as it is humanly possible.

THE TREATMENT OF MENORRHAGIA BY RADIUM.

By SIR G. BLACKER, M.D., F.R.C.P. Lond., F.R.C.S. Eng., Obstetric Physician to University College Hospital.

(Reprinted, with permission, from "The Lancet," March 3, 1923, p 421.)

HÆMORRHAGE from the uterus has now been treated by the intra-uterine application of radium in a sufficient number of cases to enable us to form a judgment as to the class of case for which it is suitable and the results which may be obtained. Radium can be used for the treatment of menorrhagia in three conditions—viz., cases in which the bleeding is associated with the menopause, cases in which it is due to the presence of small fibromyomata in the uterus, and cases in which it occurs in young women who present no signs of general or pelvic disease. Excessive hæmorrhage at the menopause is not uncommon, and the loss may be so marked as to give rise to a high degree of anæmia. In the great majority of these cases the bleeding ceases spontaneously sooner or later, and no special treatment is called for, but in other cases the loss of blood is so great that it is necessary to take steps to arrest it. In this variety medicinal remedies have very little effect, and in the worst cases such measures as plugging the vagina or the cavity of the uterus, temporarily closing the cervical canal with sutures, or even hysterectomy, may have to be resorted to to arrest the bleeding. All these cases can be safely and efficiently treated by the intra-uterine application of radium, and this should always be employed in preference to any of the other measures when radium is available.

PROBLEM OF EXCESSIVE HÆMORRHAGE AT THE MENOPAUSE.

Whether we regard this excessive hæmorrhage at the menopause as due to some disturbance of the secretions of the internal glands, or to premature senility of the uterus, resulting in an excess of fibrous tissue in its walls, the so-called fibrotic uterus of some writers, radium is equally applicable and certain in its results. It is a possible but unproven hypothesis that women who lose severely at the climacteric are the possessors of unduly fibrotic uteri which have undergone early and excessive senile changes, and that the presence of such an excess of fibrous tissue is the explanation of the fact that without any apparent cause some women bleed excessively at this period of life, while other women pass through the change without any disturbance in the

regularity of or in the amount of blood lost at their periods. It may well be that women vary in the proportion of fibrous tissue present in their uteri at the menopause just as different individuals vary in the amount of fibrous tissue in the walls of their arteries at the same ages. Such a hypothesis would explain the failure of drugs to arrest the bleeding in these cases, at any rate those drugs which depend for their action on the setting up of uterine contractions.

LIMITATIONS OF USES OF RADIUM.

While radium is especially useful in the treatment of excessive hæmorrhage at the menopause, it may also be employed for the arrest of hæmorrhage due to the presence of small fibromyomata in the uterus, or that occurring in young women without any apparent cause. Its use in fibromyomata of the uterus should be strictly limited to small tumours not larger than the uterus at the fifth month of pregnancy; not undergoing any form of degeneration; not complicated by any accompanying disease of the appendages; not causing pressure or other symptoms referable to their size; and not projecting markedly into the interior of the uterus. Within these strict limitations radium gives good results in arresting the bleeding and in ultimately causing shrinkage of the tumours. It should not be employed when the cavity of the uterus is much distorted, and it is wiser not to use it in submucous tumours for fear of injury resulting to the capsule of the tumour which might be followed by infection and sloughing of the growth. Although it is quite possible to bring about arrest of hæmorrhage and shrinkage of the fibromyoma when it is larger than a five months pregnant uterus, yet tumours of this size are best dealt with by operation and are unsuitable for radium treatment.

From time to time severe hæmorrhage occurs from the uterus in young women who are not the subjects of any general or pelvic disease, and whose age excludes the possibility of a premature menopause being a causative factor in the bleeding. In these cases it is common to obtain a history that curettage has been performed unsuccessfully on one or more occasions and that drug treatment has failed. By the intra-uterine application of suitable doses of radium it is possible to produce either complete or temporary amenorrhœa, and if the hæmorrhage returns the procedure can be easily and safely repeated.

TECHNIQUE OF INTRA-UTERINE APPLICATION OF RADIUM.

The technique of the intra-uterine application of radium is quite simple. The patient is prepared as for a curettage; under the anæsthetic a careful bimanual examination is made, particular attention being paid to the detection of any disease of the appendages. The cervix is dilated and an exploratory curettage is carried out, the scrapings being carefully preserved for microscopic examination. The interior of the uterus is douched out with hot lotion at a temperature of 118-120° F., and swabbed out with iodine or adrenalin if the bleeding is at all severe. The tube of radium, adequately screened, is introduced into the uterus up to the fundus; it is then withdrawn half an

inch and the cervical canal plugged with ribbon gauze to prevent the tube slipping down into the cervix. The vagina is also lightly plugged with gauze. For convenience of withdrawal the ribbon gauze should have a piece of thread attached to it. At the end of the period of treatment the vaginal plug is removed, the cervical plug withdrawn by its thread, and finally the radium tube extracted by the piece of silk or silk-worm gut attached to its carrier.

If the cervix has been adequately dilated up to the size of a No. 14 Hegar dilator no difficulty is, as a rule, experienced in withdrawing the tube; if, however, any difficulty does occur it can be readily overcome by gentle continuous traction. In some patients the presence of the tube *in utero* produces marked sickness, which persists until it has been removed, and in other women an attack of vomiting occurs at the time the tube is extracted through the cervix. The patient should be kept in bed for four to five days. In the case of a large uterus it may be necessary to use two tubes arranged tandem fashion in the same piece of rubber tubing.

The screen for an intra-uterine application should be such as to cut off all the beta and softer gamma rays, so as to allow only the hard penetrating gamma rays to pass and act on the tissues. In the cases recorded in this paper the screens used were composed of 2 mm. of lead and 3 mm. of rubber for radium emanation tubes, and 1 mm. platinum and 2 mm. rubber for tubes containing radium element. Other screens of an equivalent density of gold, aluminium or brass may also be employed. The secondary rays, which are formed in the lead or platinum screen (rays of Sagnac), are effectively filtered off by the use of the 2-3 mm. thick rubber covering. It is desirable in treating cases of the same kind to use similar screens, so that accurate comparisons of the results may be attained. One of the objections to the use of radium is that it requires an anæsthetic, but in reality this is an advantage, inasmuch as it allows of a thorough pelvic examination and an exploratory curettage being carried out, important factors in safeguarding the patient from the employment of the method in unsuitable conditions, and in avoiding the possibility of overlooking malignant disease.

DOSAGE.

The determination of the proper dosage is one of the difficulties in radium treatment. The average dose required in the treatment of hæmorrhage at the menopause may be said to be from 2,000-2,400 mg. or millicurie hours. In cases of fibromyomata of the uterus such a dose may have to be repeated on one or more occasions, and in the case of young women in whom it is desired to produce only partial or temporary amenorrhœa the amount used should be smaller, or, if the same, should be applied for a shorter period of time. Different patients, especially young women, appear to react to the same dose in very varying degrees, that is, exhibit different degrees of so-called "radio-sensibility," and it is therefore not always easy to determine the exact dose which will bring about a complete arrest of the periods, temporary arrest for varying periods of time, or only a diminution in the amount of blood lost.

With increasing experience, however, we shall be better able to determine the exact dose required to bring about any desired effect. It is still a matter of difference of opinion whether the best results are obtained by the use of large doses for a short period of time or of smaller doses employed for a longer period of time, or repeated on one or more occasions. It is important to avoid any skin reaction, and at the same time it must be remembered that the age of the uterus does not always correspond to the age of the patient, and patients of similar ages may react very differently to the same dose of radium.

The terms "milligramme hours," and "millicurie hours," have been introduced by Dawson Turner to indicate the duration of the exposure. In these terms the dose is expressed by multiplying the number of milligrammes of radium element, or the numbers of millicuries of radium emanation used, by the time in hours of the exposure. While this method is not strictly accurate, it provides a fair estimate of the effective dose employed, if at the same time the nature of the screens and the distance from the surface of the skin when the application is made externally are also given. The activity of a millicurie of radium emanation in gamma rays corresponds to the gamma ray activity of a milligramme of radium element.

In using radium emanations due allowance must be made for the gradual decay of the emanation, amounting, roughly, to three-quarters of 1 per cent. per hour. For clinical purposes it is sufficiently accurate to assume that 100 mg. applied for one hour, or a dose of 100 mg. hours, produces the same biologic effect as 50 mg. applied for two hours. Radium should never be introduced into the uterus in any case in which there are signs of inflammation of any part of the genital tract, and great care must be taken to exclude disease of the uterine appendages. For this reason a careful bimanual examination of the pelvis should be practised before the tube is introduced, and the interior of the uterus explored so as to exclude with certainty the possibility of any malignant disease.

IMMEDIATE RESULTS.

It is best, whenever possible, to carry out the treatment at a time when the patient is not actually bleeding. The intra-uterine application of radium with proper technique in carefully selected cases may be said to be free from any danger. If it is used in cases of chronic pelvic peritonitis it may set up an acute attack, but the same result may follow any other pelvic procedure in such a case. The method does not, as a rule, give rise to any marked pain; some patients complain of general discomfort in the lower abdomen, and in others, after the sickness due to the anæsthetic has passed off, nausea may be complained of or vomiting may even persist until the tube has been removed. No rise of temperature occurs in an uncomplicated case, such as so often follows the use of radium in carcinoma of the uterus.

In a certain number of the cases complete amenorrhœa follows the treatment immediately, in others one or two often excessive losses occur before the cessation of the periods is brought about. This is more likely to be the case in

young women or in those with fibromyomata of the uterus rather than in women at the menopause. In a few cases troublesome leucorrhœa or a slightly blood-stained discharge lasts for some four to six weeks, rarely for some months. It appears to result from the local destructive action of the radium on the endometrium, and is more likely to follow the use of large doses.

If the treatment brings about the complete cessation of the periods, the minor symptoms of the menopause, such as flushings, usually follow. In cases in which the periods return after an interval it is not uncommon to find that the flushings have ceased simultaneously, and the administration of a second dose, if followed by amenorrhœa, will again cause the onset of these vasomotor disturbances.

The excessive bleeding which not infrequently immediately follows the radium treatment has been ascribed to the liberation of hormones, brought about by the destruction of Graafian follicles in the ovaries by the radium. In the majority of patients the cessation of the periods is followed by an improvement in the general health. Occasionally severe nervous symptoms may ensue on the menopause; thus, one of my patients, who before treatment suffered from extreme attacks of depression at the periods, which were excessive, has since their cessation developed severe melancholia and religious mania. In this case a dose of 2,700 millicurie hours internally, and one of 1,320 millicurie hours externally, brought about an arrest of the bleeding after four periods. In three cases radium burns with vesication and superficial ulceration followed the external application of large doses of radium applied over the ovarian regions. In these cases the doses used were 540, 1,000, and 1,100 millicurie hours, the emanation being screened with 2 mm. of lead, 3 mm. of rubber, and three thicknesses of lint. It has been calculated that the uterus will stand a dose three times greater than that required to produce a skin reaction, and in applying radium over the ovarian region it is most important to follow the technique suggested by Simpson, and by means of suitable pads to distribute the radium used over a plane surface of sufficient size, and to place it at a sufficient distance from the skin to obviate any risk of causing injury to the superficial tissues.

IS DAMAGE BROUGHT ABOUT BY RADIUM TREATMENT?

It has been suggested that the damage done by so powerful an agent as radium to the tissues of the uterus might cause in after years the production of a carcinoma of the body of the uterus. It is true that a few cases of carcinoma have been described as occurring after the use of radium, but there is no evidence to show that the radium application played any part in their causation. Leda J. Stacy has described three cases among 1,013 cases treated at the Mayo Clinic by radium for benign conditions in the pelvis. In one case a patient, 55 years of age, who six and a half years previously had been operated upon for prolapse of the uterus, was treated in March, 1920, with a dose of 600 mg. hours of radium for hæmorrhage from the uterus. In January, 1921, she complained of an odourless bloody discharge, and received

a further dose of 700 mg. hours and X-ray treatment to the abdomen. In January, 1922, she had abdominal pain and discharge; hysterectomy revealed a carcinoma of the fundus uteri. In a second case a patient was given an intra-uterine application of radium of 500 mg. hours for fibromyomata of the uterus; this was followed by amenorrhœa for two years. At the end of two and a half years she developed a blood-stained discharge and abdominal pain, and the uterus when removed showed a carcinoma of the body.

Jacobs has described the case of a woman of 47 with small fibromyomata of the uterus, who was treated for profuse menorrhagia in October, 1919, with 148 mg., applied for 48 hours, above the pubes and in the cervix, and this treatment appears to have been repeated every three weeks for four months. In June, 1920, she had had no periods for three months. In July she developed severe hæmorrhage and an offensive discharge, masses of growth came away through the cervix, and she died in September. In this case the patient would appear to have received the enormous dose of 33,600 mg. hours of radium; there is, however, no record of any intra-uterine exploration, and the tube was placed in the cervical canal, not in the uterus. The history suggests the development of a sarcoma rather than a carcinoma. If any large series of cases of menorrhagia are treated with radium, a proportion of them is certain to develop cancer of the body of the uterus, but it would require a very large number of observations to establish any definite relation between the use of radium and the development of malignant disease.

SERIES OF CASES TREATED PERSONALLY.

During the period July, 1916, to the end of June, 1922, I have had under my care 77 patients treated by the intra-uterine application of radium emanation or radium element. Of these nine unfortunately have been lost sight of. Of the remaining 68, 34 were treated for profuse hæmorrhage at the menopause, 23 for hæmorrhage associated with fibromyomata of the uterus, and 11 for menorrhagia unaccompanied by any general or pelvic disease. Of the 34 cases at the menopause the ages varied from 40 to 52 years. All of them were suffering from severe hæmorrhage calling for treatment, 10 of them had been curetted unsuccessfully on one or more occasions (one 18 times!), and one had had five X-ray treatments with no result. The average dose of radium emanation employed in these cases was 2,000-2,400 millicurie hours, varying from 1,200-3,280 millicurie hours; the largest external dose employed was 1,020 millicurie hours, and the largest dose given to any one patient was 2,400 and 3,280 millicurie hours in two doses at a considerable interval. Of radium element the average dose employed was 2,000-2,400 mg. hours, and the largest dose employed externally 400 mg. hours.

In 33 of the 34 cases complete amenorrhœa has resulted, in 15 immediately after the treatment, in 11 after the occurrence of one period, and in 7 after two or more periods. In one case, at the age of 46, four years after the treatment, the periods have been controlled and are normal in amount but have not yet ceased. In this case treatment was undertaken in the hope that amenor-

rhœa would result, and that very severe headaches from which the patient suffers at her periods might in this way be relieved, but this result unfortunately has not followed. It is quite likely, however, that a second application might have had the desired effect, the original dose having been the comparatively small one of 2,620 millicurie hours.

In the 23 cases complicated by the presence of fibromyomata in the uterus, the ages varied from 36 to 55 years. In all the periods were so profuse as to call for treatment. The average dose employed in this series was 2,500-3,000 millicurie hours, varying from 2,000-4,248 millicurie hours, the largest external dose used was 1,100 millicurie hours, and the largest given to any one patient 2,070 and 4,248 millicurie hours in two doses; of radium element the average dose was 2,400 mg. hours, and the largest external dose used 400 mg. hours. In 16 cases complete amenorrhœa has followed the treatment, in 10 without any further bleeding, in 3 after one period, and in 3 after two or more periods. In two cases a second application was necessary. The first, a patient, 52 years old, had suffered from menorrhagia for several years, and had a fibromyoma of the uterus reaching up to the umbilicus, the sound passing 6 inches. She was very stout, with a high blood pressure, and quite an unsuitable subject for an abdominal operation. An application of 2,070 millicurie hours in 1916 resulted in amenorrhœa lasting seven months; the periods then returned and gradually increased in amount. Four years and a half later, as the periods still continued and were excessive, the patient consented to a second application, and on this occasion a dose of 4,248 millicurie hours has resulted in complete amenorrhœa. The second dose should obviously have been given at a shorter interval after the first. In the second case, a patient, 46 years of age, with a uterus containing small fibromyomata, the sound passing $4\frac{1}{4}$ inches, a first dose of 2,425 millicurie hours, followed at an interval of 18 months by a second one of 300 millicurie hours, has resulted in complete cessation of the periods. In this case a troublesome leucorrhœa persisted for some months after the first treatment. In five cases the treatment has been unsuccessful or only partially successful, the periods having returned after one application; these will require further treatment. Two of them have recently been given a second treatment, and the others have been recommended to have this done.

The ages of the 11 patients treated for hæmorrhage not due to any general or pelvic disease varied from 22 to 42 years. Two were under 30 years of age, eight between 30 and 40, and one 42 years of age. In six of these patients complete amenorrhœa has resulted after one or more periods, two have undergone hysterectomy, and in three the hæmorrhage has been controlled by the treatment. The average dose in these cases varied from 600 to 3,186 millicurie hours, the average being 2,000-2,400 millicurie hours, the largest dose given at one time being 2,700 millicurie hours inside the uterus and 1,320 millicurie hours through the abdomen over the ovarian regions.

Of the three patients in whom the treatment has been successful in controlling the excessive losses at the periods, the first, a nullipara 22 years of

age, had suffered from severe menorrhagia, and had been curetted without any result. She was profoundly anæmic and unable to follow her occupation. The first dose of 2,900 millicurie hours was followed by marked diminution in the amount lost at the periods, which became irregular and scanty; this condition lasted for one year, and at the end of that time the periods returned and gradually became excessive again. The administration of a second dose of 2,400 millicurie hours, 17 months after the first, has resulted in complete amenorrhœa after one period, and the patient is now, a year later, in very good health and able to work hard. The second case was that of a patient 28 years of age, who had been curetted and had had 15 applications of X rays for excessive periods with little benefit. The menorrhagia followed an attack of influenza shortly after the birth of the last child in January, 1919; an intra-uterine application of 3,100 millicurie hours was given in January, 1920, and since then the periods have been irregular and scanty. In the third case, a patient 33 years of age, who had suffered from menorrhagia for some years and had been curetted with no benefit, two applications of 2,400 millicurie hours, at an interval of 20 months, followed by an external application of 450 mg. hours 18 months later, have controlled the loss. The periods are now regular and normal in amount, provided that the patient rests at the time.

In two of these 11 cases hysterectomy has been performed; in one, a woman 37 years of age, after one application of 2,380 millicurie hours, amenorrhœa resulted for four and a half months. The periods then returned, and the patient went to another hospital, where the uterus was removed. The second case was that of a woman of 40 with severe menorrhagia, in whom complete amenorrhœa for 12 months followed an application of 2,400 millicurie hours; at the end of this time there were slight irregular losses with a complaint of pain down both legs, and nine months later the patient underwent subtotal hysterectomy at another hospital. The uterus when removed showed no signs of disease.

The amenorrhœa following the application of radium is no doubt due to its effect upon the ovaries and the destruction of the Graafian follicles which it brings about; it also produces some local destructive effect upon the mucosa of the uterus, but the not infrequent return of the periods in young women shows that these effects may be merely temporary and may be entirely recovered from. No doubt the recurrence of the periods is associated with the maturation of fresh Graafian follicles in the ovaries. It has been suggested that the radium may produce a direct effect upon the tissues of a fibromyoma, but this is doubtful; the shrinkage of these tumours which undoubtedly follows is no doubt due to the onset of the menopause. A sufficient number of cases of pregnancy with the birth of healthy children have been recorded, after the use of radium in young women, to show that when the periods return normal pregnancy may occur, and there is no evidence that the children of such pregnancies are more likely to be maldeveloped or deformed, although monstrosities can be produced if pregnant animals are exposed to the action of radium in the early weeks of pregnancy.

The results obtained by those who have employed radium in the treatment of hæmorrhage from the uterus show that it is a valuable and efficient method of controlling excessive hæmorrhage at the menopause; that it can be employed safely for the same purpose in small uncomplicated fibroid tumours of the uterus, and that by its means excessive menorrhagia in young women which resists ordinary methods of treatment can be brought under control.

For the radium used in the treatment of the patients under my care in University College Hospital I am indebted to the Medical Research Council, who have kindly lent the hospital authorities 500 mg. of the salt for purposes of research and treatment. The details of the cases treated in the hospital have been more fully set out in a report furnished to the Council.

REFERENCES.

- Turner, Dawson, F. D., "Radium, its Physics and Therapeutics," 1914.
Stacy, Leda J., *Amer. Jour. Roentgenology*, 1922, IX, 658.
Jacobs, C., "Gynécologie et Obstétrique," 1920, II, 376.
Simpson, F. E., "Radium Therapy, 1922, with a complete bibliography.

UNUSUAL CALCAREOUS DEPOSITS IN THE SOFT TISSUES OF THE HANDS.

By J. R. LOGAN, M.B., Consulting Physician, The Royal Liverpool Children's Hospital.

M. M., a lady of about 60, has had trouble with her hands and feet as long as she can remember. In the earlier years she suffered from chilblains in these parts, and for more than fifteen years past she has suffered much from cold hands and feet, especially in the winter, but often in summer as well. The hands generally have a dusky bluish appearance, and I look upon the condition as a mild variety of Raynaud's disease. The ears have been damaged by chilblains and there are blue vein radicles on the face and on the tongue. On the fingers and thumbs there are a considerable number of lumps, which give them an irregular appearance; they are hard, generally quiet, but sometimes they become acutely inflamed and suppurate. Then it has been that I have been able to get a number of the calcareous nodules for examination. The nodules are almost exclusively on the flexor surfaces and on the sides of the digits. The pieces which I have been able to examine have been somewhat oval in shape, and the largest had a diameter of about 3 mm. Some of them were of stony hardness and broke with a vitrious fracture; others were more spongy. Treated with dilute HCl. on a glass slide the white substance dissolved with the evolution of a little gas, leaving a few cellular bodies behind, but no definite tissue.

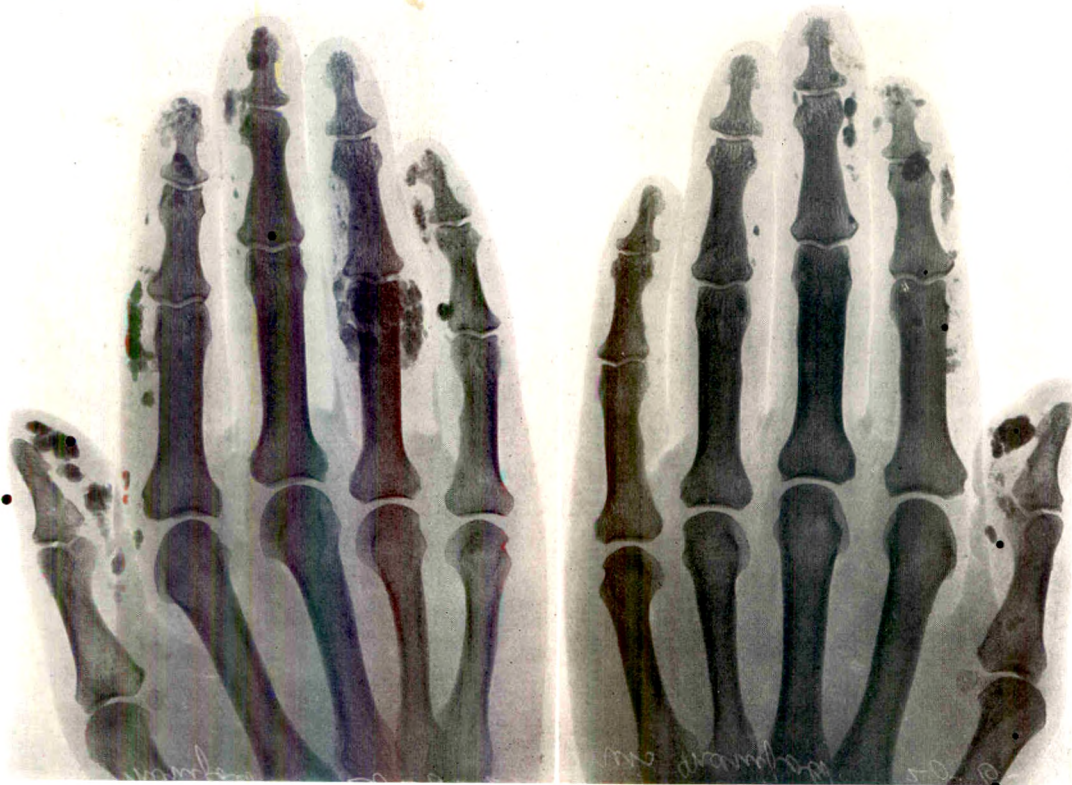
Dr. Geo. Tate analysed the substance for me, and reports that it is composed of phosphate and carbonate of lime, and that there is no trace of uric acid.

Treatment has had no effect; in fact, in the past nine months there has been an increase of deposit in the left ring finger.

There is a hard nodule in the helix of each ear, but repeated examination shows nothing of the sort in the feet. In the past, however, there has been

trouble of some kind in each little toe—and both of those have been removed some years ago.

The X-ray pictures were shown at the Liverpool Medical Institution on April 12th, and Dr. Thurstan Holland has been good enough to send me references to a few somewhat similar cases. (1) A case of his own, a calcerous nodule in the flesh of the arm; (2) calcerous nodules in the calves of the legs—said to be trichiniasis—reported by Dr. Goldsbrough, *Lancet*, March 18th, 1918, p. 46-8.; (3) a case of Dr. Barclay's (of Manchester)—calcareous nodules in an angioma; (4) a case of Gilbert Scott's (of London), a large irregular deposit of phosphate and carbonate of lime in a thumb after a whitlow;



and (5) "a case of subcutaneous calcareous concretions," reported, with radiograph, in the *Bull. Soc. Franc. de Dermatologie et Syphilographie*, 1919; p. 266, which he considers practically identical with my case. "L'examen histologique pratiqué a montré autour des nodules calcaires une réaction de cellules conjonctives très marquée. Dans cette réaction conjonctive on distingue des capillaires en réaction endothéliale et à l'intérieur de ces capillaires, des corpuscule calcaires." It seems to me that there is a similarity in this case to mine, but not identity.

I see in the last *Lancet*, 19th May, 1923, a reference by Dr. F. Parkes Weber to my case, and also to one of his own, in which the calcareous nodules were associated with sclero-dactylia. Dr. Weber refers to several published cases.

TECHNIQUE RADIOGRAPHY OF THE KNEE JOINT.

By E. SCOTT, M.B., B.Ch. (Oxon), Hon. Radiologist, Ashford Cottage Hospital.

I PROPOSE to describe a method of obtaining a radiogram to give a comparative antero-posterior view of both knee joints. When the joints are radiographed from below in the usual manner, with the patient supine, the following difficulties arise on account of the obstinate flexion which is so commonly associated with an injured or diseased knee.

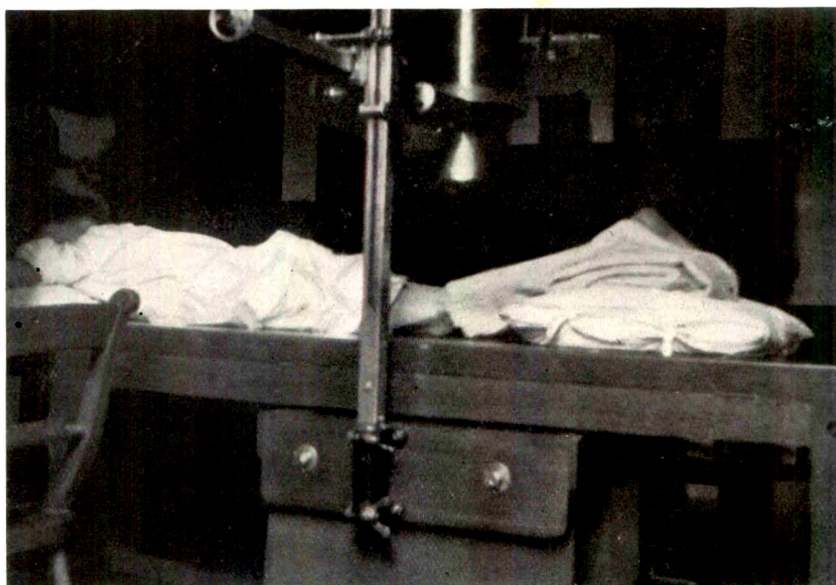


FIG. 1.

1. Difficulty of immobilising the plate in front of the flexed joint.
2. Difficulty of maintaining the same degree of flexion in both joints so as to obtain an accurate symmetrical picture.
3. Difficulty of eliminating spasmodic movements.

I have lately adopted the following method :—

The patient lies prone. The trunk is straight, and the thighs should lie flat and in close apposition to the surface of the table. If proper attention is paid to this detail, it will be found that the foot on the injured side tends to be raised in order to maintain the position of flexion at the knee joint. One or more pillows are then placed transversely beneath the insteps and lower parts of the shins until the affected limb is supported in a comfortable position. The other leg, being equally supported by the same number of pillows, will naturally correspond. The position is a restful one. The radiogram is taken with the tube above the couch; the rays are directed vertically downwards

and centred on the mid-point between the knees at the level of the transverse crease at the back of the joint.

I enclose explanatory photograph and a print from a radiogram taken in this way to show the normal appearances.

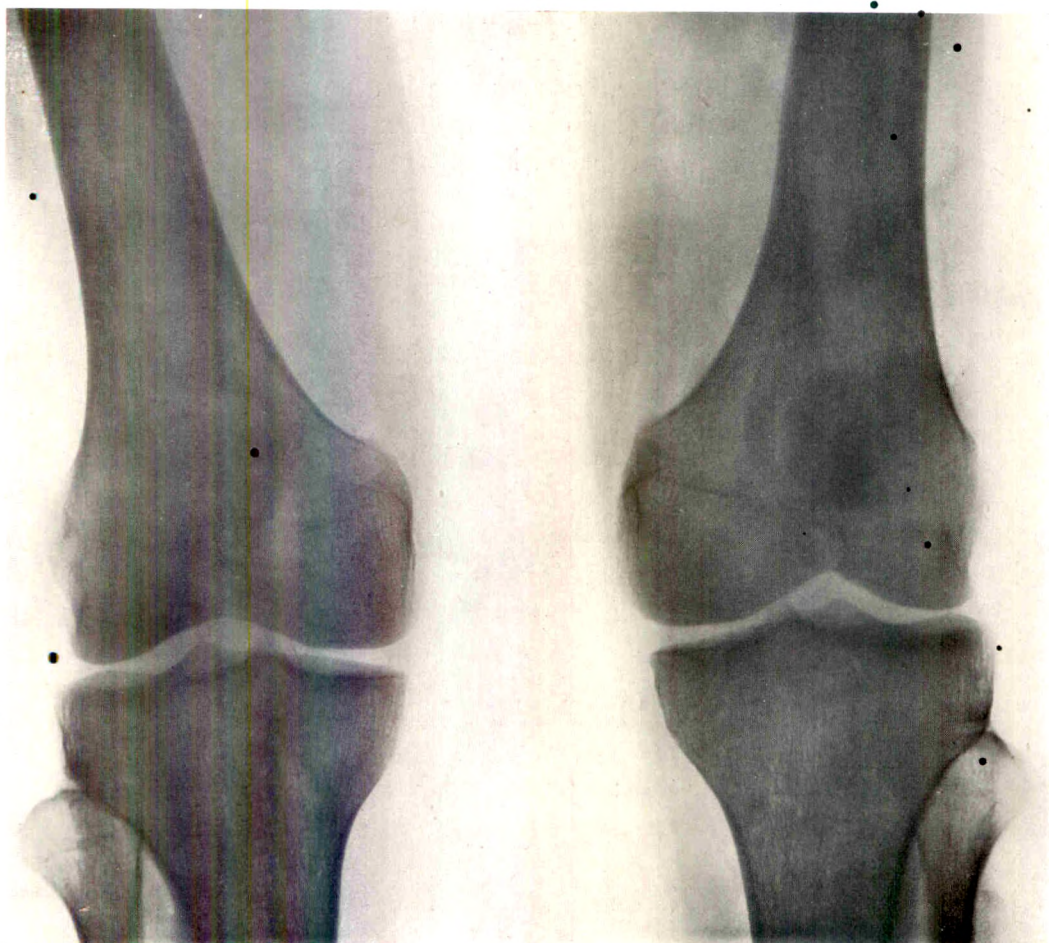


FIG. 2.

[Dr. Scott has found the position he describes useful in a number of cases. The method is a recognised one for the examination of the knee joint, particularly in cases where a picture of the patella is required. This position should always be employed when good detail is essential. The importance of keeping the limbs at rest is emphasised by Dr. Scott.—EDITOR.]

A NOTE ON THE DISCREPANCY IN THE VALUES OF SECONDARY VOLTAGE GIVEN BY THE SPECTROMETER AND THE EQUIVALENT SPARK-GAP.

By W. E. SCHALL, B.Sc.

THE discovery by Duane and Hunt that there is a simple relationship between the electro-motive force (V) applied to the ends of an X-ray tube, and the boundary wave-length (λ_0) of the radiation produced in the tube, is expressed by the equation :—

$$V = \frac{12358}{\lambda_0}$$

Thus, if we know the boundary wave-length from a spectrometric measurement, we can calculate the voltage which propelled the cathode stream. Moreover, the work of March has shown that if we know the value of the boundary wave-length, we also know the composition of the beam of X rays, because the energy distribution throughout the emission spectrum obtained from an X-ray tube depends solely on the value of λ_0 and on the filter used. This value can therefore be used as an accurate definition of the quality of the rays.

The voltage of the discharge from a spark coil or a transformer can also be measured by the length of spark which is produced between spheres, and tables have been drawn up connecting these two values. It would appear, on first consideration, that the reading of the equivalent spark-gap gives us the voltage applied to the ends of the tube, and that from this can be calculated the value of λ_0 by the above formula, thus rendering spectrometric measurements unnecessary. And, indeed, equivalent spark-gaps are being made which are not only calibrated in kilo volts, but also in corresponding values of λ_0 in Angstrom units.

Unfortunately, the matter is not so simple as this. The first thing which strikes an observer making simultaneous measurements of λ_0 with a spectrometer, and of the secondary voltage with the equivalent spark-gap, is that the voltage calculated from the observed value of λ_0 is always less than that measured on the equivalent spark-gap, often by as much as 15 per cent. There are two reasons for this. One is that frequently voltage is lost between the terminals of the equivalent spark-gap and the tube in the form of corona discharge, or on account of valve tubes, spark-gaps or other similar apparatus which are placed in circuit.

The other and more important reason, however, is that the passage of a spark across the equivalent spark-gap is the commencement of a discharge after a period, no matter how short, of no discharge. That is to say, the equivalent spark-gap measures the no-load voltage of the secondary. The spectrometer, on the other hand, gives the λ_0 of the radiation produced when the electrons of the cathode rays are actually flying, *i.e.*, when current is being taken from the secondary, and therefore the spectrometer gives us the voltage actually existing under load.

Now, no-load voltage and load voltage differ considerably in the case of a

spark coil, and to a lesser degree in the case of a transformer. They probably never differ to the same extent for any two tubes and installations or any two loads. And, moreover, the difference between the two values for the voltage will be less when a Coolidge tube is used than with a gas tube, because of the absence of the ionising voltage in the former, which is necessary in the latter.

If, therefore, the equivalent spark-gap, whose readings are in Angstrom units, has not been carefully calibrated spectrometrically on its own particular apparatus at various loads with various tubes, its readings will be entirely inaccurate.

And if it is calibrated in kilo volts, its readings are open circuit voltages, and the E.M.F. which actually propels the electrons is a smaller one.

CORRESPONDENCE.

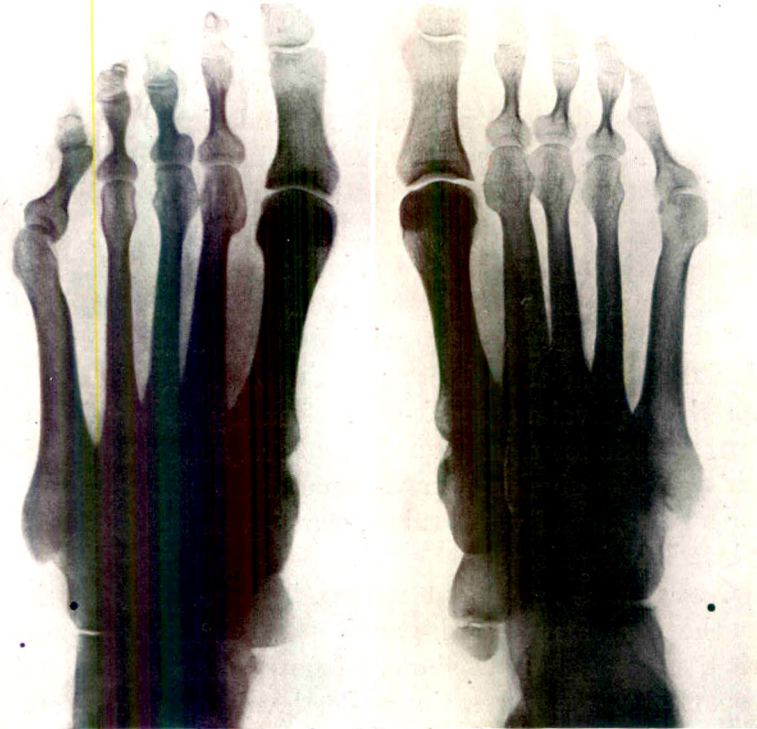
To the Editors of ARCHIVES OF RADIOLOGY
AND ELECTROTHERAPY.

DEAR SIRS,

In the January number of the ARCHIVES there is a short article on a supernumerary bone

between suggesting that there is a very definite articular surface.

The clear outline of the astragalus in the right foot differs from that in the left, in which there is a distinct tibiale externum.



of the tarsus. I am enclosing prints of a case I X-rayed a few weeks ago, a woman about 40 years. In the right foot there is a very distinct and separate bone on the inner and posterior part of the scaphoid, the space

The scaphoid in the left foot appears to be normal.

Yours faithfully,
CHAS. R. DYKES, M.R.C.P. & L.R.C.P.
Radiologist, Forest Hospital, Buckhurst Hill.
May 31st, 1923.

UNIVERSITY OF CAMBRIDGE.

*Examination for the Diploma in Medical Radiology and Electrology.
July, 1923.*

The following Candidates have satisfied the Examiners in Part I (Physics and Electrotechnics):

Gunewardene, Hubert Oliver
Hayes, Richard

Hodgson, Harold Kingston Graham

E. RUTHERFORD
J. A. CROWTHER
SIDNEY RUSS } *Examiners.*

6th July, 1923.

The following Candidates have satisfied the Examiners in Part II (Radiology and Electrology):

Bodas, Narayan Mahadev
de Glanville, Lionel Richard Gethin
Frizell, Malcolm
Gunewardene, Hubert Oliver
Hastings, William Howitt (*Trin.*)
Hayes, Richard
Joshi, Mahadev Dattatraya

Kellock, Anna Taylor
Luyt, Gabriel Julian
Moir, Margaret Jane
Sheret, Jessie Evelyn
Warden, Sorab Byramji
Whitby, Edward Vernon

ALFRED E. BARCLAY
E. P. CUMBERBATCH
F. SHILLINGTON SCALES } *Examiners.*

6th July, 1923.

NOTES AND ABSTRACTS.

The Roentgen Diagnosis of Ulcus Duodeni with Respect to the Local "Direct" Roentgen Symptoms.—AKE AKERLUND, Stockholm (*Acta Radiologica*, Vol. II, Fasc 1, pp. 14-30).—With regard to the technique for the examination of the duodenum, the author recommends an intimate co-operation between fluoroscopy and roentgenography; he describes a few simple arrangements for the exact adjustment of small plates and for the taking of small serial pictures of the duodenum in different positions of the body. The pictures are adjusted under fluoroscopic control in the most suitable directions of projection. The author especially recommends examination in upright position.

The changes in the form of the bulb constitute the central point in the direct roentgen diagnosis of the duodenal ulcer. The author

distinguishes four kinds of ulcer deformities in the bulb: (1) niche; (2) defect; (3) retraction; and (4) diverticulum.

According to the author, the bulbar niche is by no means rare. Out of material of about 100 positive cases of duodenal ulcer, collected during the course of two years at a hospital, he observed the niche symptom in the bulb in rather more than 60 per cent.

The bulbar niche is most often localised to the lesser curvature side, which is refracted. As a rule, a local, circular and often spastic constriction (defect) occurs in the niche plane from the greater curvature side. The bulbar deformity hereby arising, which may be called a miniature picture of the ulcer deformity of the stomach, constitutes in the author's opinion the most typical ulcer deformity in

the bulb and has been confirmed by him in more than 50 per cent. of the above mentioned cases.

The author ascribes a certain importance to the spastic, circular, bulbar constriction in the



FIG. 1.

Typical ulcer deformity of the bulb: niche and retraction of the lesser curvature side, corresponding constriction of the greater curvature side, the pylorus wide open, eccentrically situated.

ulcer plane, which usually appears more marked during the later stages of digestion, in respect to the cause of the "paradoxical" four hours retention by uncomplicated duodenal



FIG. 2.

ulcers with initial hypermotility, and very likely also in respect to the origin of the typical hunger pains.

The spastic shortening (retraction) of the longitudinal muscles, which are particularly strongly developed in the medial bulbar region,

and which may result in a pyloric insufficiency directly observable in the roentgen picture, offers a mechanical explanation of the initial hypermotility.



FIG. 3.

Among the differential-diagnostically important affections the author especially mentions those of the gall-bladder and new growths of the bulb.

The author's statistics from operative and



FIG. 4.

Cases of typical bulbar deformity, with niche on the retracted medial bulbar side at some distance from the open eccentric pylorus, and segmentary constriction in the ulcer plane from the lateral side.

post-mortem material show correct roentgen diagnosis in rather more than 60 per cent. ;

correct diagnosis of probability in a further 20 per cent. In the remaining cases it was

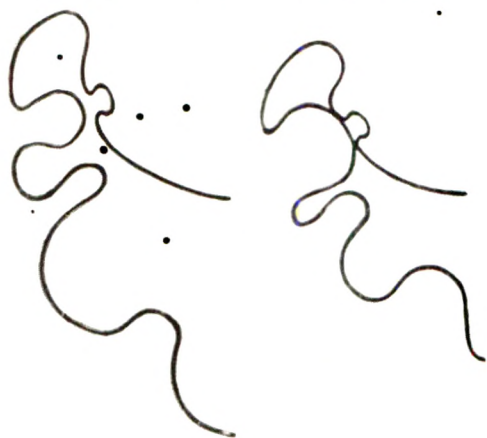


FIG. 5.

Typical niche deformity of the bulb at the beginning and at the end of gastric digestion.

not possible to make a roentgen diagnosis or it was only made alternatively. The roentgen

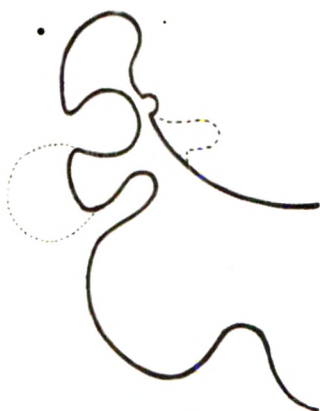


FIG. 6.

Ulcer diverticulum on the medial and lateral side of the bulb.

diagnosis was obviously incorrect only in five or six of the total number of cases.

On the Question of the Distribution of Intensity of the Gamma Rays in the Proximity of Medicinal Radium Preparations.—ROLF N. SIEVERT, Stockholm (*Acta Radiologica*, Vol. II, Fasc. 1, pp. 70-76).—The above article shows that most of the assertions given in this journal (vol. I, p. 475, 1922) by O. Glasser regarding the distribution of γ -ray intensity in short distances from medicinal preparations are quite untenable. Further, it is pointed out that mistakes will easily be

made in the use of the word "Isodoses" as the name for lines or planes of equal intensity.

A Technical Detail in Dental Roentgenography.—G. RENCK, Stockholm (*Acta*

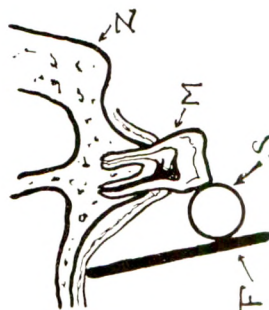


FIG. 1.

The film placed parallel to the molar by means of the spiral spring. F, film; M, molar; S, spring; Z, zygomatic process.

Radiologica, Vol. II, Fasc. 1, pp. 74-76).—During intraoral roentgenography of the molars and premolars, the author recommends hooking on a spiral of electroplate either directly on to the film or on the film holder.

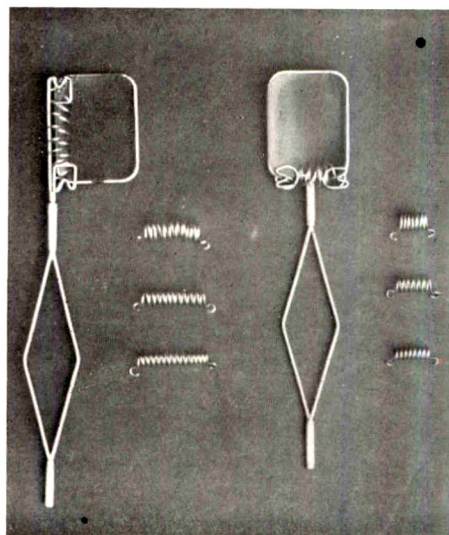


FIG. 2.

The spring mounted on a Victor-Leach's film holder.

By this means we can get the film and the longitudinal axis of the tooth parallel, so that the tube can be centred in a direction below the zygomatic process without the risk of elongating the dental roots.

PUBLICATIONS RECEIVED.

Journals.

- Acta Radiologica*, June 15th, 1923.
L'Actinoterapia, March 30th, 1923.
Archivio Italiano di Chirurgia, May, 1923.
British Journal of Dermatology and Syphilis, July, 1923.
Bulletin of the Johns Hopkins Hospital, June, 1923.
Bulletin et Memoires de la Société de Radiologie Médicale de France, June, 1923.
Bulletin Officiel de la Société Française d'Electrotherapie et de Radiologie, May, 1923.
La Chirurgia degli Organi di Movimento, June, 1923.
Foto-Radio-Terapico, 1922-1923.
Health, June, 1923.
Hospitalstidende, June 13th, 20th, 27th, 1923.
International Journal of Orthodontia, Oral Surgery and Radiography, June, 1923.
Kongresszentralblatt für die Gesamte Innere Medizin und ihre Grenzgebiete, June 18th, 25th; July 2nd, 9th, 1923.

Journals—continued.

- Journal of Laryngology and Otology*, July, 1923.
Journal de Médecine de Bordeaux, June 25th, 1923.
Journal de Médecine de Lyon, June 20th, 1923.
Journal de Radiologie et d'Electrologie, June, 1923.
Journal of Radiology, June, 1923.
Journal of the Röntgen Society, July, 1923.
Medical Journal of Australia, April 14th; May 19th, 26th; June 2nd, 1923.
Medical Science, July, 1923.
New York Medical Journal and Medical Record, June 20th; July 4th, 1923.
New York State Journal of Medicine, June, 1923.
Norsk Magazin for Lægevidenskaben, May, 1923.
Il Policlinico, June 1st, 15th, 1923.
La Revue de Stomatologie, June, 1923.
Surgery, Gynecology, and Obstetrics, July, 1923.
Ugeskrift for Læger, June 26th, 1923.
Urologic and Cutaneous Review, July, 1923.

NOTICES.

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A list of collaborators at home and abroad is being prepared and will be published at an early date. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

OBSERVATIONS ON X-RAY CANCER.

By J. HENRY DIBLE, M.B., M.R.C.P., Lecturer on Bacteriology in the University of Manchester, and J. M. WOODBURN MORISON, M.B., C.M., Hon. Assistant Radiologist, Manchester Royal Infirmary (from the Department of Pathology, The University of Manchester).

THE condition of X-ray carcinoma is one that is especially interesting in connection with experimental work upon the production of carcinoma generally. This has now been induced in animals by a variety of procedures, all having in common the prolonged application of irritant substances to the skin or mucous membranes. It is often held that the essential in such experiments is the presence of a specific substance stimulating the growth of epithelial tissues, and attention has been directed to the finding of such fractions of these substances as may be especially active, and the possibility of concentrating, or of extracting, the essential portion in a state of some purity by chemical methods. X-ray carcinoma, therefore, stands in the rather unique position of being caused by a purely physical agency, and if growth-promoting substances are present, they are certainly not connected with the prime irritant; for this reason the occurrence of the condition should be kept well in mind. Further, such lesions are becoming rare, and are likely to become still rarer under constantly improving technique, so that from many points of view such cases as come to light at the present time are worth recording.

The occurrence of skin lesions was first described by Marcuse (1) in 1896, and a fatal case of carcinoma was recorded in 1904. Malignant disease has also been produced experimentally in the rat by Pierre Marie, Clunet and Raulot-Lapointe (2). These authors consider that epithelioma might result, in place of the sarcoma which they produced, if the rays act over long periods and in low doses. In their experiments the rats, which are more prone to sarcoma than to carcinoma, were exposed at long intervals to intense irradiation. It is interesting, in this connection, to note that Porter (3) has reported a case of neoplasm in the human subject, following years of exposure to rays, which Mallory found difficulty in deciding as to whether it should be classified as a sarcoma or "an unusual form of reparative action on the part of the connective tissue"; we have also been shown, by Professor Shaw Dunn, sections from a similar growth in which the appearances are highly suggestive of sarcoma, and the slides closely resemble those figured by Porter.

The case we are about to describe in the present paper is that of Mr. J. S., *et. 76*, which came under our observation in 1921. The patient has been engaged in the practice of radiology for the last twenty years at the Oldham Infirmary. He worked for the greater part of this period in a small room and was never more than five or six feet from the tube when this was in use. He is married but has no children.

The onset of skin trouble was rather indefinite, but about 1911 he began to experience a burning sensation in the hands which was worse at night and particularly after a long day's work with the rays. He did not use gloves before this time, but when these symptoms appeared he began to employ them and thereafter used them as often as was possible. He soon noticed that "the skin and tissues began to shrivel up and warts formed on the back of my hands, which later began to discharge." There was no severe pain, such as has been a prominent symptom in many of these cases, the irritation and burning sensation being the most noticeable symptom and causing much discomfort as well as loss of sleep. These symptoms persisted throughout the whole time that the lesions were present. The ulcerated areas extended and refused to heal in spite of numerous forms of treatment, and one of them became very large and took on characters which suggested a malignant change. The condition of the hands in June, 1921, which is shown in the accompanying photograph (Fig. 1) was noted as follows:—

RIGHT HAND.—*The thumb.* Is in fair condition, showing one or two small warts.

First finger. Warts are present around the root of the nail and over the dorsum of the proximal phalanx.

Second finger. Presents the most marked lesions. A large indolent ulcer with raised edges, nearly an inch in diameter, is present on the radial side of the middle phalanx. A smaller ulcer is seen on the dorsum of the proximal phalanx and a small wart, which is breaking down, is present upon the metacarpo-phalangeal joint.

Third finger. Shews numerous small warts, one of which, on the dorsum of the proximal phalanx, is breaking down.

Little finger. Numerous small warts are present. The skin on the dorsum of the hand generally is thin and atrophic.



Right.



Left.

FIG 1.—Mr. J. S., aged 75 years.

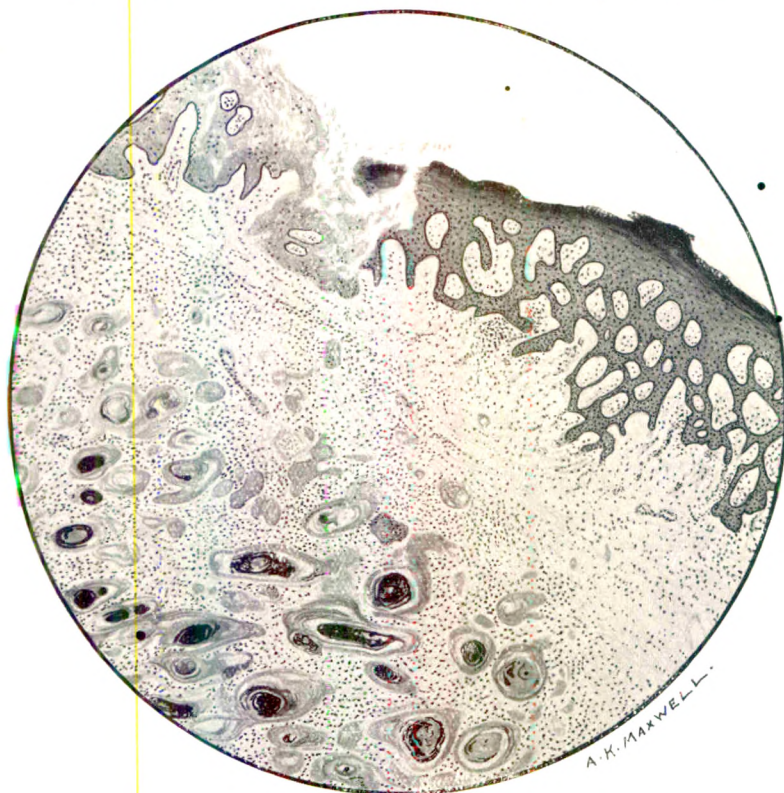


FIG. 2.—Low power view of the epitheliomatous area.

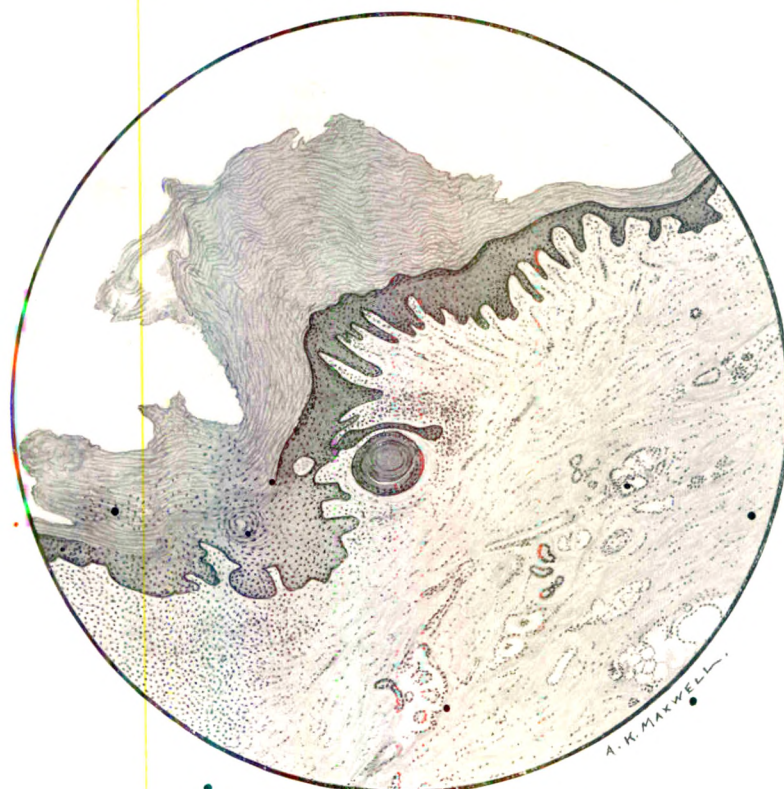


FIG. 3.—Suspicious changes in an area showing hyperkeratosis.

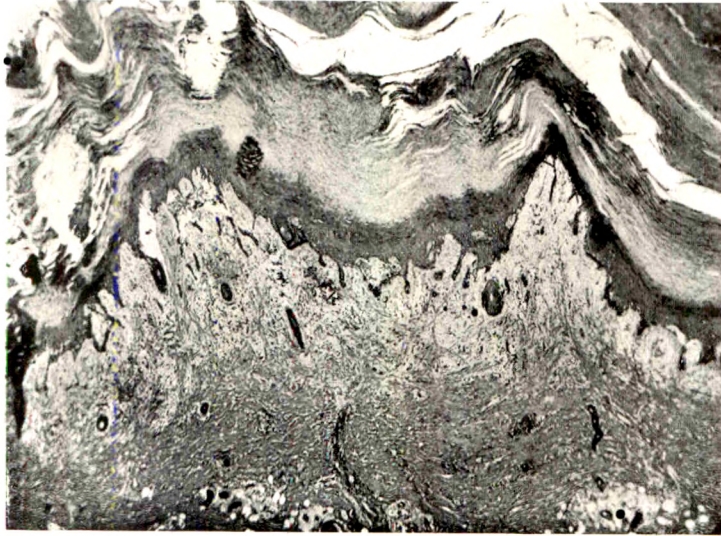


FIG. 4.—X-Ray wart. There is in this particular instance an cedematous condition of the underlying corium. 1" obj.

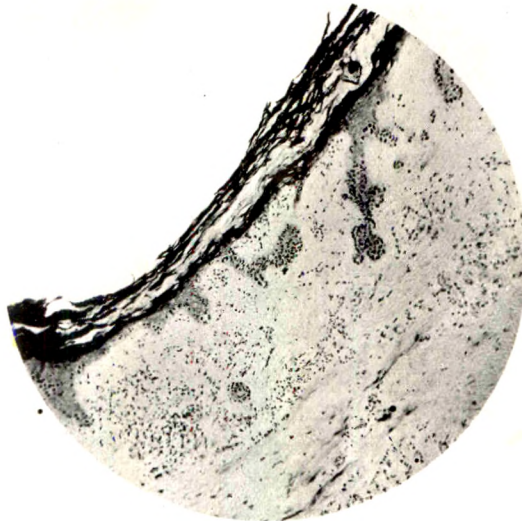


FIG. 5.—Atrophy and distortion of the Malpighian layer in the vicinity of the other lesions. $\frac{2}{3}$ " obj.

In the left hand many small warts are present on the backs of the phalanges, but the hand is much less severely injured than is the right, and the skin over the metacarpals is in fair condition.

Owing to the disability all X-ray work was given up in May, 1921, and, a diagnosis of malignant change having been made, the first, second and third fingers of the right hand were amputated at the metacarpo-phalangeal joints by Dr. A. H. Godson, of Oldham, on June 8th, 1921. The wounds healed well.

Histological examination of the main ulcerated area on the right hand was made, and sections were also examined of warts in different stages of development. The large ulcerated area just mentioned showed the presence of a typical squamous-celled carcinoma, differing in no essential features from tumours of this type arising spontaneously in the skin. The epithelial down-growths penetrate deeply into the subcutaneous tissue whilst cell-nest formation with keratinisation is exceedingly well marked. Fig. 2 shows a low power view of this region in a section stained by iron hæmatoxylin, which throws into prominence the keratinised portions of the growth. This section, which is through the edge of the ulcer, shows the breaking-down skin and the infiltration of the underlying corium with epithelial down-growths, as well as the marked lymphocytic reaction around the malignant tissue. It will be noticed that keratinization in the cell nests is a very well marked feature, and that the sections show but little epithelium in its cellular state. This suggests a well developed degree of differentiation, associated with slow growth; the cells tending to mature rather than proliferate rapidly, which would suggest a low type of malignancy, a feature which accords with the clinical history. The section also shews to a very marked degree the irregular and hyperplastic form of the skin epithelium bordering the malignant area; a series of changes which it is common to find in the vicinity of any malignant epithelial growth. Fig. 3 is a section from a fissured wart which was not clinically malignant. The microscopic appearance shows, in addition to the thickened papillomatous up-growth of epithelium, a definite disturbance of the normal relationship of epithelium and corium. The Malpighian layer, below and to the left of the warty portion, is hypertrophic, its processes are broadened, and, when seen under a higher power, more cellular, showing evidence of active growth. The stratum granulosum is broken up and lost in the region in question. There is also a definite cell nest lying below the papilloma, and the subjacent corium is infiltrated by lymphocytes. We have, therefore, in this region a wart which is associated with such alterations, and active growth of the epithelium, which is beginning to penetrate the corium, as suggest commencing malignancy.

Sections of the isolated single warts with which the fingers were peppered show only a condition of simple hyperkeratosis. (Fig. 4.) The picture in the rest of the skin varies in different places. Whilst in some parts the epithelium and subcutaneous tissues appear normal, in other places the epithelium is

definitely atrophic and represented by a thin and attenuated Malphigian layer (Fig. 5). Here and there, beneath the epithelium, are little groups of lymphocytes, and the former shows more irregularities than are met with in the skin of a normal finger; all facts pointing to the infliction of destructive injuries to the parts at some time or other. The hair follicles are still present, and the endophlebitis and telangiectases which are so often described in these cases are not noticeable features. There is but little fat around the sweat glands, and the subcutaneous tissue is more fibrous than is usual in the average finger, but neither of these changes are very prominent, and the age of the patient may be a factor here.

SUBSEQUENT HISTORY.

Mr. J. S. was again seen early in February, 1923, and examined. He was 76 years of age, and, except for some chronic bronchitis, in good health. The condition of the hands had improved continuously since the operation, and was found to be as follows:—

The right hand showed satisfactory healing of the operation wounds and no trace of any recurrence; all breaches of surface being healed. A few warts were present on the existing fingers. The skin over the dorsum of the hand was thin and pigmented, but the hairs were present. On the left hand a few small, hard, scattered warts were observed, but no ulceration. He states that the local irritation is getting less and less troublesome and that the warts are shrinking. The nails were in good condition. No glandular enlargements were present. Thus, the condition of the patient, a year and eight months after amputation of the fingers, was entirely satisfactory.

The prognosis in X-ray carcinoma seems very varied. Porter and White (*loc. cit.*) collected details of eleven cases in 1907, of which five, and possibly six, had ended fatally. It is difficult to obtain precise information upon the subject, but, in looking over the reported cases, one gains the impression that when the disease spreads it does so pretty rapidly, and, on the other hand, that in another class of case it tends to remain local, is exceedingly callous, and has little tendency to spread. Thus, in Porter's case, after a long period of dermatitis, malignancy was diagnosed in 1902 and in 1907, after ten years of treatment, for five of which cancer has been present and twenty-seven minor operations performed under anæsthetics, carcinoma was found in the most recently removed portion of tissue; yet the disease was still confined to the fingers and had not spread beyond them. This is in keeping with our knowledge of the experimental production of epithelioma in animals; some are susceptible and some are more resistant. With the X rays we have an agent whose tendency to produce malignant epithelial proliferation is known, and it is conceivable that the readiness with which it does so, and the rapidity with which the disease spreads when once it is inaugurated, are functions of the individual's susceptibility, other things being equal. Where such a variety of different factors are in play, as conditions of

working, nature of the apparatus, age of the person, and the very important question of added chemical irritation, where the hands were exposed to developers as well as to the rays, it is impossible to compare case with case and to find out if there is any relationship between the time of the appearance of skin lesions and the time of the onset of malignancy and, further, between this last and the prognosis; but on *a priori* grounds it would seem very possible that where the disease is produced with difficulty, in an unsusceptible subject, that the prognosis is good provided that adequate treatment is applied, and *vice versa*.

REFERENCES.

- (1) W. Marcuse. Deutsche Medicinische Wochenschrift. "Dermatitis und Alopecie Nach Durchleuchtungsversuchen mit Röntgenstrahlen." 1896, Vol. XXII, p. 481.
- (2) MM. Pierre Marie, Jean Clunet, Gaston Raulot-Lapointe. "Nouveau cas de tumeur maligne provoquée par une radiodermatite expérimentale chez le rat blanc." Association Française pour l'Etude du Cancer, March, 1912. (Abstract in *La Presse Médicale*, 1912, XX, p. 255.)
- (3) C. E. Porter and C. J. White. "Multiple Carcinomata following X-Ray Dermatitis," *Annales of Surgery*, 1907, Vol. XLVI, p. 649.

ELEVATION OF THE DIAPHRAGM. UNILATERAL PHRENIC PARALYSIS. A RADIOLOGICAL STUDY, WITH SPECIAL REFERENCE TO THE DIFFERENTIAL DIAGNOSIS.

By J. M. WOODBURN MORISON, M.B., C.M., Hon. Assistant Radiologist, Royal Infirmary, Manchester; Lecturer Applied Anatomy—Radiological, Manchester University.

(Continued from Vol. XXVII, No. 274, p. 364).

HISTORICAL NOTE.

We have now to consider those cases of elevation of the diaphragm in which there is a definite pathological lesion involving the phrenic nerve, usually in its passage through the thorax; but other cases are recorded by Weigert and also by Kofferath, in which injury to the phrenic nerve in the neck, during birth, has produced a similar condition.

It is stated in Oppenheim's text-book of "Nervous Diseases," 1911, Vol. I, p. 423, that "paralysis of the nerve is not common," and that "a unilateral phrenic paralysis is difficult to recognise as the functional disorder is very slight. It can usually be detected by careful examination. Absence of the so-called 'diaphragmatic sign' (Litten), *i.e.*, the visible movements of the diaphragm accompanying inspiration and expiration, may be of assistance in diagnosing a unilateral or bilateral phrenic paralysis."

I think it will now generally be admitted that unilateral phrenic paralysis is not uncommon. It is a condition which can definitely be diagnosed radiologically. Within the last two years I have seen nine cases, and in two of these cases I was able to confirm the diagnosis post mortem.

In two of the cases the right phrenic nerve was involved, and in seven of them, the left. Three of the cases occurred in secondary carcinoma of the mediastinum, one of which was secondary to carcinoma of the stomach and the other two were secondary to carcinoma of the breast.

Of the remaining cases three were associated with pulmonary tuberculosis, two with growth in the chest and one with aneurysm of the aorta.

GENERAL DESCRIPTION.

Disease or injury may affect either the right or the left phrenic nerve, causing paralysis of the corresponding leaflet of the diaphragm. The left appears to be more frequently involved than the right. In left phrenic paralysis, except for the fact that there is a definite pathological condition or a history of injury, the radiological signs are those of eventration of the diaphragm. The points requiring investigation are those which I tabulated in discussing eventration. We find:—

1. The bow line found by the paralysed diaphragm stretching across the hemithorax as an unbroken line.
2. The contents of the dome are the air sac of the stomach and part of the colon, but just as in Pettit's eventration, the colon may be present on some occasions and at other times absent.
3. Lung tissue was seen through the dome in some cases, in others consolidation of part of the lower lobe of the lung altered the physical conditions and this sign was absent.
4. The movements of the bow line were reversed, except in those cases in which adhesions to the lung were present. In some of these cases the elevated diaphragm was fixed, in others very slight reversed movements were seen.
5. The level of the stomach contents was the level of the cardiac orifice.
6. Palpation of the abdomen produced waves on the horizontal line of fluid in the stomach.
7. Displacement of the heart to the right was not a marked feature of these cases.
8. Development and movement of the chest wall: The development of the chest was normal in all cases, and so far as I could judge from observation there was no difference in the expansion of the two sides of the chest. This question of the movements of the chest wall is, however, of great importance from an anatomical standpoint, and I am now able to show by graphic records that in these cases there is a difference in the movements of the two sides. I shall discuss this question in more detail later on under the heading anatomical considerations.
9. The deformity of the stomach previously described as occurring in Pettit's eventration was occasionally present.

It is thus seen that paralysis of the left phrenic nerve, due to a pathological lesion, presents radiologically the same characteristic features as Pettit's eventration. It is only a question of variation in degree, and of complications due to the presence of active disease.

In the two cases which I record in which the right phrenic nerve was paralysed, the diagnosis was based on the elevation and reversed movements of the right leaflet of the diaphragm.

I was able to obtain post-mortem examinations in two cases. In one case the phrenic nerve was involved in a cancer nodule as it crossed the root of the left lung; a section of the nerve below this area showed complete degeneration, whilst a section of the diaphragm showed degeneration of the muscle fibres, but the changes in the muscle of the diaphragm were not so advanced as one would have expected.

In the second post-mortem the phrenic nerve was involved close to the diaphragm, and again degeneration of the muscle was not so advanced as one would expect.

This suggests some auxiliary innervation of the diaphragm, and in the dissecting room branches of the intercostal nerves can be traced into the diaphragm muscle.

In "Cunningham's Text Book of Anatomy," fourth edition, p. 474, we read regarding the innervation of the diaphragm that "it is sometimes said to receive fibres from the lower thoracic nerves."

RECORDS OF NINE CASES. GROUP II.

CASE 1. W. S., male, aged 58. This man was suffering from bronchitis and pulmonary tuberculosis. At the X-ray examination I noted very definite reversed movements of the left side of the diaphragm, and on the strength of the reversed movements I was able to make a definite diagnosis of paralysis of the left side of the diaphragm due to involvement of the phrenic nerve.

Post-mortem, it was found that the left phrenic nerve was involved in a mass of fibrous tissue throughout a distance of $2\frac{1}{2}$ inches. There was atrophy of the muscle of the diaphragm on the affected side.

CASE 2. H. L., male, aged 50. In this case there was a definite intra-thoracic growth, with complete recurrent laryngeal nerve palsy. The screen examination showed a moderate degree of elevation of the left side of the diaphragm with complete reversed movements; it conformed in all respects with the radiological signs described under eventration of the diaphragm.

CASE 3. A. S., female, aged 52. This was a case of secondary carcinoma of the mediastinal glands, ten months after a radical operation for cancer of the breast. The screen examination showed marked enlargement of glands in the posterior mediastinum and infiltration of a portion of the lower lobe of the left lung, just above the diaphragm. The diaphragm was only slightly raised, and its movements were limited—they were very definitely reversed.

CASE 4. C. P., male, aged 54. A case of intra-thoracic growth, causing paralysis of the right phrenic nerve with reversed movements of the right diaphragm. The diaphragm was slightly elevated on the right side, but not markedly so, except on deep inspiration.

CASE 5. Mrs. B., female, aged 45. A case of secondary mediastinal carcinoma, three years after removal of the left breast. The left side of the diaphragm was elevated, giving the typical bow line in the chest—its movements were reversed, and all the signs present described under eventration.

CASE 6. R. O., male, aged 47. A case of tuberculosis of the right root and upper lobe, in which there was paralysis of the right side of the diaphragm with typical reversed movements.

CASE 7. A. M., male, aged 56. A typical case of carcinoma of the stomach in which there was secondary involvement of the mediastinal glands, and invasion of the base of the left lung.

The left side of the diaphragm was paralysed, its movements being reversed. There was very little elevation on account of the consolidated lung tissue. Post mortem, the phrenic nerve was found to be involved in a nodule of cancer just below the root of the left lung. Histological preparations of the nerve showed complete degeneration, and section of the diaphragm of the affected side showed marked degeneration of muscle fibre, though not so marked as one would have expected from the condition of the nerve, suggesting that there is some additional innervation of the diaphragm, presumably from the lower thoracic nerves.

CASE 8. A. G., male, aged 59. Aneurysm of the aorta. Clinically, all the physical signs of aneurysm of the arch of the aorta were present in this case, and the X-ray examination confirmed the diagnosis. To the left of the aortic arch a shadow could be seen with an irregular edge spreading downwards to the root of the left lung. The diaphragm was elevated on the left side and the movements reversed. In this case there was evidently paralysis of the left phrenic nerve associated with aneurysm.

CASE 9. W.S., male, aged 52. There was extensive tuberculosis of the left lung, and to a lesser extent, of the right. The left diaphragm was elevated and partially fixed. Very slight reversed movements were observed.

ANATOMICAL CONSIDERATIONS.

The diaphragm, the large powerful musculo-tendinous structure which separates the thorax from the abdomen, is specially suitable for radiological investigation because of the contrast which its heavy shadow makes with the lighter shadow of the lungs.

Its normal position varies slightly. In adults in the erect position the central tendon is usually about the level of the eleventh dorsal vertebra. The right dome rises to the height of the lower border of the fifth rib, and the left to the upper border of the sixth rib.

At birth the position of the diaphragm is higher, the central tendon being at the level of the eighth to the ninth dorsal vertebrae. It becomes lower when the child begins to walk, and gradually reaches the level of the eleventh dorsal vertebra.

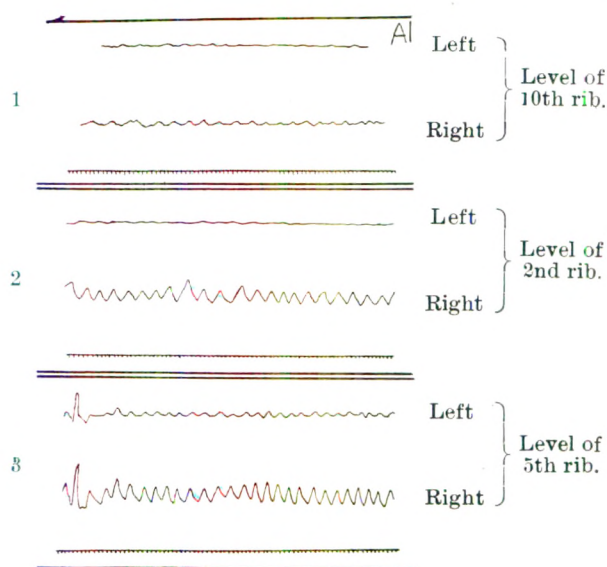
The right leaflet resting on the liver is visible throughout its whole extent. The left leaflet rests on the stomach, but here the inner part is obscured by the heart shadow which also obscures the outline of the central tendon. The outline of the diaphragm below the heart becomes apparent during forced inspiration. In the lying-down position there is a marked diminution in the extent of the movements of the diaphragm. I have also observed that when lying on one side there is a lessened excursion of the leaflet of the diaphragm of that side. Normally the movements of the two leaflets are synchronous.

During inspiration, the powerful downward thrust of the diaphragm on the right side depresses the liver, etc., but on the left side the air cap of the stomach acts as a buffer taking up the force of the diaphragm movement. The stomach during an X-ray examination can be seen to alter in shape with the action of respiration. During inspiration it becomes shorter and broader, but the lowest part of the greater curvature does not alter in position. This holds good in whatever position the body is placed, although the air in the stomach may not be immediately under the diaphragm. In some of the lower animals, e.g., the dog, cat, rabbit, the air cap does not lie immediately under the

diaphragm, but it can be seen to take up the thrust of the diaphragm by its elasticity. The gas forming the air cap is composed mainly of atmospheric air swallowed in taking food.

MOVEMENTS OF THE CHEST WALL AND DIAPHRAGM.

In the cases of elevation of the diaphragm (Groups I and II) which we have previously considered, I described the movements of the paralysed diaphragm as being reversed except in those cases in which adhesions to the lung had formed, preventing any movement. In Group I, Case 1, it was noted that after the adhesions were divided, full reversed movements of the affected leaflet took place, and persisted until fresh adhesions formed. This paradoxical respiratory movement is, I think, the cardinal feature of a phrenic paralysis.



A. O'B., Group I, Case 1.

It is best observed radiologically during quiet breathing. During forced breathing when the accessory muscles of respiration come into play the upward and outward movements of the ribs tend to flatten even a paralysed diaphragm.

In all these cases it was noted that the chest wall was equally well developed on the two sides, and as one of the principal actions of the diaphragm is to raise the lower ribs in the act of inspiration, I looked for a difference in the expansion of the two sides of the chest. I was unable to satisfy myself that there was such a difference. Discussing this question with Dr. McSwiney, of the Department of Physiology of Manchester University, I found that some time ago he had designed a "respiratory jacket," by means of which graphic records of the chest movements could be obtained.

A record of the movements of the chest in the case of A. O'B., Group I, Case 1, was obtained, and shows an almost entire absence of movement over the lower ribs of the affected side, thus supporting the anatomical teaching as to the action of the diaphragm in elevating the lower ribs. (Tracing 1.)

It also shows that the greatest chest movement on the left side was about the level of the fifth rib, although much diminished as compared with the right. (Tracing 3.)

Another point of interest was the almost entire absence of movement over the left apical region. (Tracing 2) Sir Arthur Keith, in the Hunterian Lectures on "Man's Posture: Its Evolution and Disorders," Lecture III, *B.M.J.*, March 31st, 1923, p. 547, in writing of the development of the apical region of the lung, shows that "for the proper aeration of the apical part of man's lungs diaphragmatic movements are essential." We are investigating other cases, and they will form the subject of another communication.

POSITION OF THE HEART.

The question of displacement of the heart to the right in eventration of the diaphragm, large diaphragmatic herniæ, and in extensive pleural effusions, is of interest.

Dr. R. J. M. Buchanan, of Liverpool, recently showed at the post mortem examination of a case of extensive diaphragmatic hernia, that the apparent displacement of the heart to the right was in reality a rotation. This is also well seen in the radiograms of cases of large pleural effusions.

The term dextrocardia has been used by some writers on eventration in describing this displacement of the heart to the right, but it seems to me that this term should only be used for cases of true congenital transposition of the heart.

THE PHRENIC NERVE.

In the cases recorded under Group II we have seen how the phrenic nerve may become involved by disease in its passage through the thorax.

Recently cases have been recorded by Weigert and Kofferath, in which the phrenic nerve has been injured in the neck with a resulting paralysis of the corresponding leaflet of the diaphragm. Originating from the fourth cervical nerve, with sometimes a not inconsiderable addition from the fifth and also the third, it is easily seen how the phrenic nerve may be injured at birth. With the advance of radiology records of such cases will become more frequent.

ÆTIOLOGY AND LITERATURE.

The usual statement found in the literature is that the ætiology is still obscure. Petit regarded the condition as being of congenital origin.

Cruveilhier, writing on this subject, says that it is J. L. Petit who seems to have given the name eventration to abdominal herniæ, that is, to the displacements which result from the loosening or dilatation with thinning out of the abdominal walls. He regarded the diaphragm as subject to a loosening, exactly like that of the anterior abdominal wall, similar causes acting on the diaphragm. He described the thinned out distended diaphragm as forming a pocket, which had lost all power of contraction and which enclosed the abdominal viscera. He quoted Petit's case only, and evidently

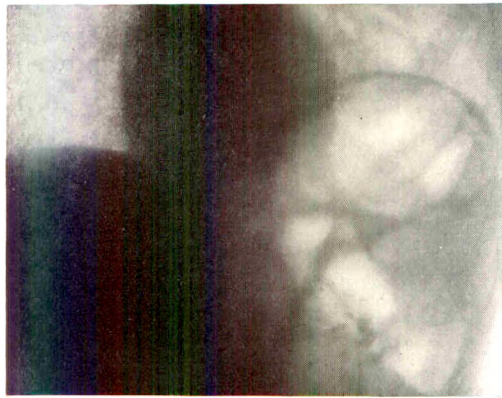
did not regard the condition as being of congenital origin. (*Traité D'Anatomie Pathologique Générale*, J. Cruveilhier, 1849, Vol. I., p. 614-617).

Most of the cases recorded have been in adults, but there is one case of an autopsy of a foetus in which eventration of the left side of the diaphragm was found. Another autopsy of a new born infant revealed a similar condition. These were the cases of Pyl and Meckel, and were quoted by Laacher.

Stein records a typical eventration of the left side of the diaphragm in a new born child which lived twenty-six days.

In this case the left leaflet of the diaphragm was a thin fibrous structure extending high up into the thorax, with no muscular fibres.

Thoma laid great stress on the hypoplasia of the left lung, it having been often noted at post-mortem examinations that the lower lobe of the left lung was abnormally small. He says, "When the lung is too small the diaphragm



CASE 1.—W. S., male, aged 58 years. Pulmonary tuberculosis and bronchitis. Paralysis of the left diaphragm.

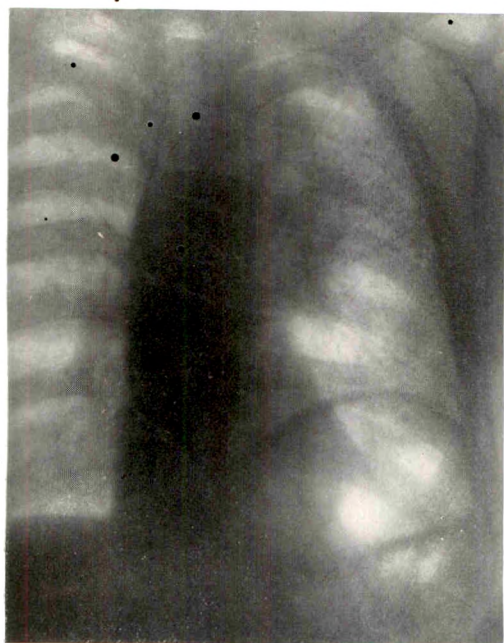
risers to fill the space in the pleural cavity, dragging the intestinal contents with it."

Doering put forward the theory of a congenital deficiency of the muscles of one side of the abdomen. He points out the deficiency in the muscular tissue of the affected leaflet of the diaphragm and the symmetrical condition of the thorax. The weak diaphragm fails to expand the lung, and assumes the high position dragging the viscera with it. This theory is not supported by the post-mortem examinations, as the condition of atelectasis has never been found. It is interesting to note that Thoma, in support of his theory that the lung is chiefly at fault, cites the presence of muscular fibres in the diaphragm, whilst Doering cites the deficiency of muscular tissue in the diaphragm as a reason in support of his opinion.

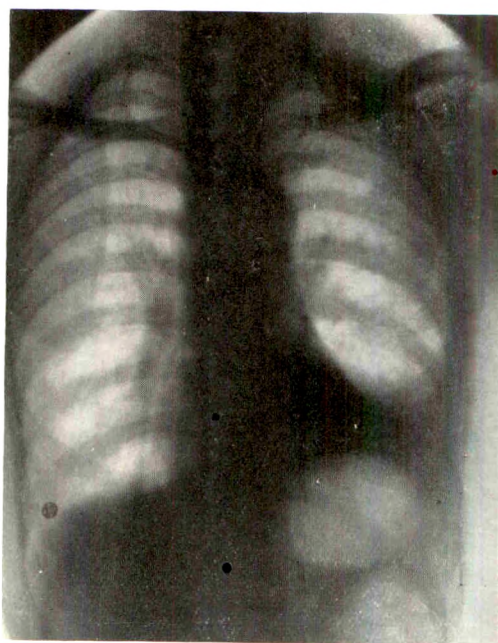
Baetze regarded it as developmental, whilst Vogel thought there was a congenital predisposition with degenerative changes in the muscular fibres.

Motzfeldt thought it due to :—

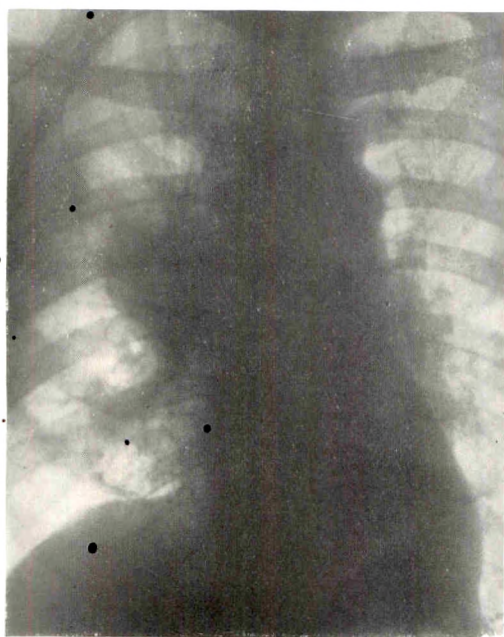
1. Primary aplasia of the musculature with secondary atrophy and degeneration of the phrenic nerve.



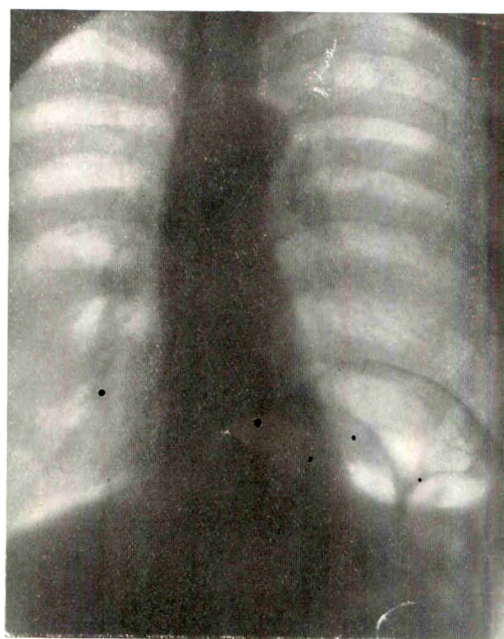
CASE 2.—H. L., male, aged 50 years. Intrathoracic growth with paralysis of the left diaphragm.



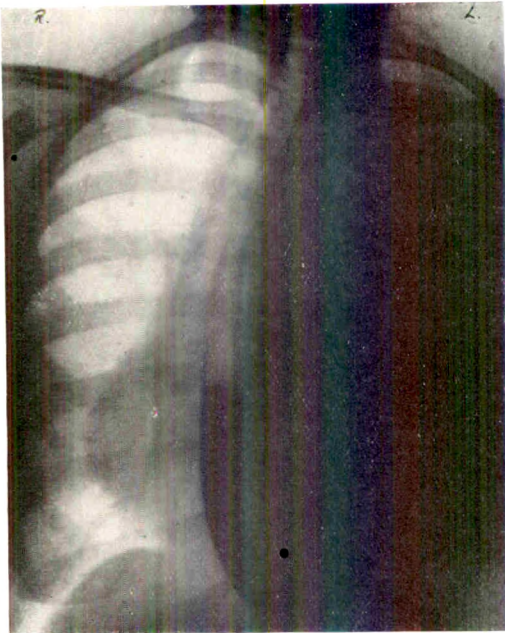
CASE 3.—A. S., female, aged 52 years. Secondary carcinoma of lung with paralysis of the left diaphragm.



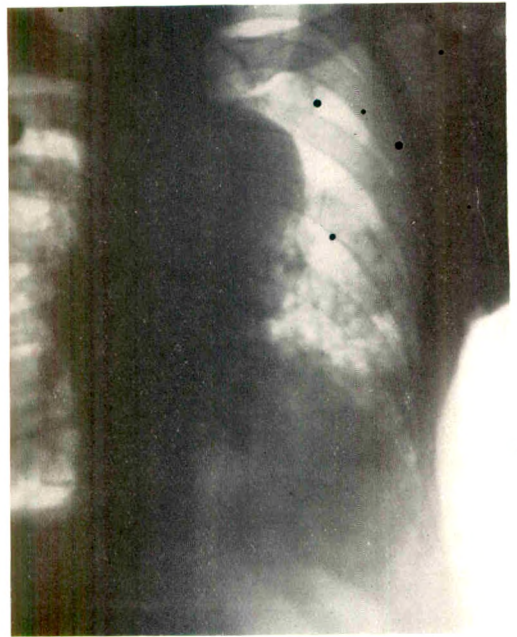
CASE 4.—C. P., male, aged 54 years. Intrathoracic growth with paralysis of the right diaphragm.



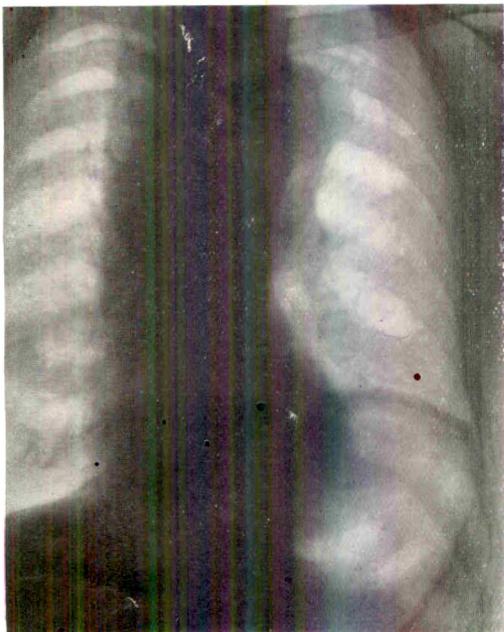
CASE 5.—Mrs. B., female, aged 45 years. Secondary mediastinal carcinoma with paralysis of the left diaphragm.



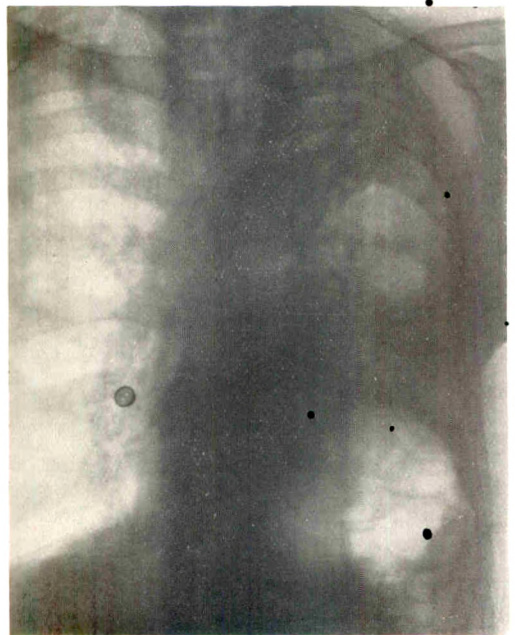
Pleural effusion. Large pleural effusion—left side—edge of which extends beyond the middle line. The heart is shown on the right side—rotation of heart. The electrocardiographic tracings were normal. Note the displacement of the trachea and of the oesophagus, in which is a little bismuth food.



CASE 7.—A. M., male, aged 56 years. Secondary carcinoma of lung with paralysis of the left diaphragm.



CASE 8.—A. G., male, aged 59 years. Aneurysm of the aorta with paralysis of the left diaphragm.



CASE 9.—W. S., male, aged 52 years. Old standing pulmonary tuberculosis with paralysis of the left diaphragm.



Dissection of neck, by Dr. Wood, Anatomy Department, Manchester University.
Showing the phrenic nerve arising from the cervical plexus, 3-4-5. The
descendens cervicis is held to one side by a hook.

2. Primary aplasia and atrophy of the phrenic nerve with secondary muscle degeneration.

3. A combination of (1) and (2).

Tennant recorded quite a unique case of a man, aged sixty. He found post-mortem the anterior one-third of the left leaflet of the diaphragm normal, but marked off behind from the rest by a band extending from the tenth costal cartilage to the central tendon—the posterior two-thirds of the vault was lax, flabby and pushed up towards the neck in the form of a large pouch which contained a large empty stomach and part of the transverse colon. The left crus and remainder of the diaphragm were normal, as were also the lungs and heart. The left phrenic nerve was examined microscopically, but the sections did not show any abnormality. There was nothing to support the view that it was caused by any morbid condition of the lungs or pleura. The chest was not contracted. He regarded it as “a case of congenital imperfect differentiation of the diaphragm.”

Lawrence, in 1852, reported a case with the post-mortem findings, in the *Lancet*, and this same case is again reported in the *Lancet* by Marsh in 1867. It was a typical case of eventration found post-mortem in a man, aged thirty-three years, who had died of pneumonia. “The left half of the diaphragm was arched up to the third intercostal space, and the stomach, which was extremely large, was pushed up so high as to be nearly concealed by the ribs.” The right side of the diaphragm was normal. The left leaflet was a grey fibrous translucent structure with “very fine short striæ of muscular fibres extending from the inner surface of the ribs and ligamenta arcuata for the distance of 6-8 lines.” Marsh states further that “Mr. Paget thought the defect a congenital one” and that “there appeared, notwithstanding this defect, to be sufficient respiratory power. The patient breathed very forcibly in his dyspnoea, and in auscultating him the movements of the chest appeared just as in an ordinary double pneumonia. The left side of the chest certainly moved freely, and the patient often lay on his right side.”

Sailor and Rhein described a case of a farmer aged twenty years in which post-mortem a skiagram was taken which showed an eventration of the left side of the diaphragm. The points of note in this case were the displacement of the heart to the right, the presence of muscular fibres in the left leaflet and the congenital malformation and hypoplasia of the lung.

Other cases similar to those which I have quoted have been recorded by Crispino, Froriep, and Widenmann whose case was also reported by Glaser. In this case of Widenmann and Glaser it is of interest to note that the patient suffered from gastric symptoms, and on two occasions hæmatemesis occurred.

Injuries to the phrenic nerve may occur at birth and recently Weigert and Kofferath have recorded cases.

Weigert's case was due to trauma during delivery. The left half of the diaphragm was elevated and all the radiological appearances of an eventration present. He observed this case until complete recovery took place in the course of about two months.

Kofferath describes "a case of right-sided Erb paralysis and paralysis of the phrenicus following forceps delivery." The X-ray examination showed an abnormally high position of the right half of the diaphragm. The right leaflet moved in a totally abnormal manner; on inspiration it rose, and descended on expiration. After four days respiration became apparently quite normal and a later examination showed normal conditions.

It is obvious from a study of the literature that the writers have formed their theories of the ætiology of eventration of the diaphragm very largely on observations of the individual cases which they have recorded, and up to now no one has recorded more than one case.

This, I think, explains the conflicting opinions of the various writers and the statements that the ætiology is still obscure.

It must be admitted that some of these cases are of congenital origin, for we have seen that one case occurred in a foetus; but they cannot be ascribed to a failure in descent of the diaphragm, because in all the post-mortem accounts, and in two of my cases which were operated on, the skeletal attachments of the diaphragm were normal.

If, in trying to elucidate the problem, we turn to the embryology of the diaphragm, a subject which presents many difficulties, we find in "Embryology" (Prentiss and Arey), 1920, that "The diaphragm, according to Broman, is derived from four sources: (1) its ventro-pericardial portion from the septum transversum, its lateral portions from (2) pleuro-pericardial membranes plus (3) derivatives from the body wall. The dorsal portion is formed from (4) the dorsal mesentery. In addition to these, the striated muscle of the diaphragm, according to Barden (1900), takes its origin from a pair of pre-muscle masses, which in 9 mm. embryo lie one on each side opposite the fifth cervical segment. This is the level at which the phrenic nerve enters the septum transversum. The exact origin of these muscle masses is in doubt, but they probably represent a portion of the cervical myotome of this region. The muscle masses migrate caudally with the septum transversum, and develop chiefly in the dorsal portion of the diaphragm."

A failure in development of the muscle mass would appear to be a reasonable explanation of the ætiology of some of these cases of eventration.

There is, however, a second cause—phrenic paralysis.

Cases of eventration of the diaphragm due to an injury to the phrenic nerve at birth have been recorded, and we have seen that unilateral phrenic paralysis due to a definite pathological lesion gives rise to a similar condition.

From a study of my own cases of eventration and of unilateral phrenic paralysis, along with those recorded by others, I would suggest that eventration of the diaphragm may be due to two causes:—

1. A developmental defect in the formation of the muscular tissue of the diaphragm.
2. A unilateral phrenic paralysis due to injury or disease.

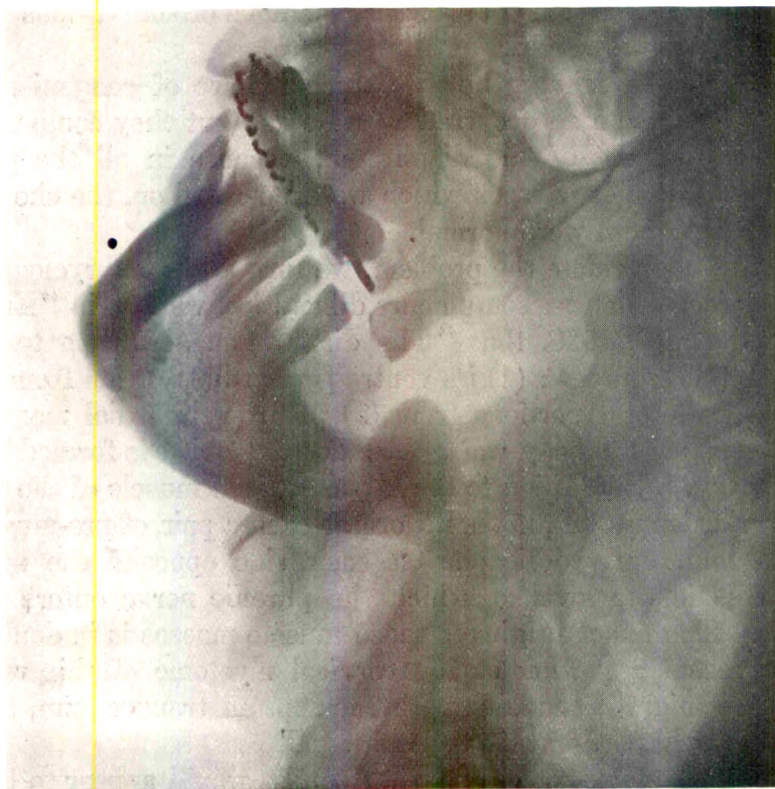
(To be continued.)

A LARGE SUBMAXILLARY CALCULUS.

By J. H. MATHER, M.B., Ch.B., D.M.R.E., Honorary Radiologist, Royal Southern Hospital, Liverpool.

THE following case is of interest on account of the size of the calculus and the long history :—

The patient, E.D., a male aged thirty-four years, was admitted to the Royal Southern Hospital with a swelling of the left side of his lower jaw.



Calculus in submaxillary gland.

Ten years previously the patient noticed a lump in the left side of his neck, extending forwards under the left mandible. It prevented him swallowing either fluids or solids. After a day or two, although the swelling in the neck persisted, the obstruction to the passage of food gradually disappeared.

Two or three times each year the lump became inflamed, and he suffered acute pain. His molar teeth, which were thought to be the cause of the trouble, were extracted one by one.

The last attack commenced six days before admission to hospital. On admission there was a swelling situated in the left anterior triangle of the neck, extending from the ear to the mid-line under the chin. It was hard, lobulated, and slightly tender, but did not fluctuate. Inside the mouth there was a hard,

extremely tender tumour on the lingual side of the lower jaw. The patient complained of pain on swallowing.

A radiograph was taken of the left side of the lower jaw, and showed a homogeneous shadow with a well defined regular outline, about the size of a large hazel nut, in the region of the wisdom tooth, and a diagnosis of submaxillary calculus was made.

The technique employed was as follows: the patient was lying on the table on his back with the head tilted upwards and to the left, the plate being placed on the left side of jaw, and the rays being directed slightly upwards between the horizontal rami.

Thurstan Holland (1) described a case using similar technique. Hickey (2) described a case in which he placed the patient on his back with the head hanging over the end of the table, and the film in the patient's mouth, the rays being directed at right angles to a plane through the horizontal rami. In both these cases very small calculi are shown.

Three cases are described in the French literature (3, 4 and 5).

Mr. Douglas Crawford operated three days later and found a large calculus present in the submaxillary gland.

The gland was completely disorganised and formed a sac of pus containing the calculus, which weighed 3.88 grammes and measured 1.9 cm. in its longest diameter.

My thanks are due to Mr. Douglas Crawford for permission to publish this case.

REFERENCES.

1. *Archives of Rad. and Electro.*, June, 1915, p. 18.
2. *American Journal of Roentgenology*, May, 1915, Vol. II, p. 177.
3. *Bull. et Mémoire de la Société Anatomique*, December, 1920, p. 649.
4. *Bull. Officiel de la Soc. Française d'Elect. et de Rad.*, February, 1921, p. 41.
5. *Lyon Médical*, December, 1921, p. 1054.

WHAT CAUSES THE HEALING ACTION OF ROENTGEN RAYS?

Summary of a paper by Dr. G. HOLZKNECHT, Professor Medical Radiology of the Vienna University. Read before the German Roentgen Society's Congress Meeting at Munich, April, 1923.

[Translation by A. E. Dean, F.Inst.P.]

For twenty-five years we have been bothering our heads over the question how Roentgen rays really act. We all know that Leopold Freund of Vienna was the first to describe and explain the effect of X-ray treatment. Few will recall his words and the first explanations of these effects. Freund assumed that the effect on the skin and hair was a consequence of electrical air discharges outside the tube. He believed that the rays had nothing to do with the matter. Freund's observation was correct, his explanation was wrong. This in no way minimises his merit of being the founder of X-ray therapy.

We know now that these effects are not to be ascribed to electrical discharges, but directly to the action of the X-rays. To be sincere we must admit we know that much and not much more. As a matter of fact we are daily committing similar errors. Do we not attribute the so-called Roentgen cachexia to foul air in the X-ray room, to the nitrous gases and electrical discharges? Is it not true that every new Roentgen effect reawakens that point of contention—should the stimulative effect of X-rays be ascribed to damage done to cells or to a selective action on function of increased cell production?

One might even ask if the constant researches on the effects of Roentgen action are not really superfluous. The X-ray effects have been so carefully observed and minutely described that we might perhaps be contented with simply confirming them.

Stephan, for example, has shown that one of the worst nephritic conditions, namely, nephritic retention or anuria, can be removed by X-ray treatment. His discovery is none the less meritorious, although his explanation of the effect, namely, that functional stimulation causes the reaction of the kidney epithelium may be equally right or wrong, as was the case with Freund. Did not cinchona bark cure malaria long before we knew anything about it? Yet elucidation is the goal of the curious and the ambition of the research worker.

Contemplate what might have become of Roentgentherapy had the first assumption been retained, namely, that Roentgen effects were created through electrical discharges outside the tube. Radiotherapy would have ceased to exist.

If the assumption is wrong, that ray treatment frequently causes functional increase, then we are in a *cul de sac*, and not for the first time, for it occurred quite recently in the case of the unit dose for carcinoma and sarcoma. In order not to go on a wrong track again, we must have light as to what Roentgen rays really do.

If one reviews recent literature a peculiar contradiction will be observed. On the one hand we cannot but notice the formidable concentration of labour and material on the part of the physicists directed to the measurement of a dose, and the infinite pains taken to assure the equal distribution of a definite amount of Roentgen energy in every cubic centimetre of the radiated human tissues; and even when these elaborate measurements showed little prospect of securing further advantages, still more experiments were initiated, and with minute precision, to further prove whether the scattering increment would or would not be increased by the use of a covering denser than the tissues; further, whether a dilated pig's bladder placed on the patient for a period of time undefined would reduce the scattering increment by 2 per cent. or so.

The tenacity with which these investigations have continued must be admired, but at times one feels that it is an over-estimated idea.

On the other hand, the problem, "How X-rays really do act," has, until very recent times, received but very scant attention. The hypotheses of Bergonié and Tribondeau were readily transferred into biological laws without very

much scrutiny, and even the Arndt-Schulz laws, dating as they do from the pre-chemistry days, are regarded as biological fundamentals.

In medicine it is usual to prescribe a dose or quantity of a medication suitable to the requirements of the individual case, and very often a relatively small dose gives place to a larger one. The best dose is that which had the least damaging effect and the greatest modifying result. Such is the proceeding on broad lines, and as long as patients and physicians exist suitable doses will have to be studiously and carefully determined for each case. But with X-ray medication the matter seems to be different. The only thing that matters is to make certain that a definite quantity of energy is plugged into every cubic centimetre of the subjected organ, and the physicist will argue that in the absence of any such exact measurements there can be no question of biological conclusions.

But again, in the case of X rays there arise two diametrically opposed actions, one of stimulation and the other of retardation, and we are confronted with four counter effects, two affecting the healthy and two influencing the pathological tissues. Yet for the four different effects the dosage lies in close proximity, and instead of rejecting as unsuitable a medication because the proper and improper doses lie in close proximity, the gigantic task of ascertaining the critical doses has been carried out. Yet should we not ask ourselves this question: "Is there a stimulative dose?" We know that Roentgen rays undoubtedly destroy living cells, we know that the destructive action varies with the sensitiveness of the cells and with the dose employed. We are informed that malignant tumours after certain treatment by Roentgen rays grow faster, but exact proof is not forthcoming. We are also led to believe that small doses of X rays promote growth; further, there are records of a whole series of experiments on seeds, buds and eggs, which describe the accelerated developments under X ray stimulation. Yet it must be remembered that natural growth has its own limits and is controlled and arrested, otherwise we should find trees growing to the clouds. Finally, we have the Arndt-Schulz formula as follows: small quantities of every agent stimulate, medium quantities retard, large quantities destroy. This formula is accommodating, lucid and insinuating, and has found general acceptance as a biological law.

This so-called law was used to justify the employment of powerful instrumentation and large doses carried out with purely physical procedure. In spite of this the complete cure of carcinoma was not attained.

In this predicament the Arndt-Schulz law was again invoked as "the saving angel," because in it rested the hope that with still more powerful apparatus and still more massive doses success might be reached. This was the *deus ex machina*.

We all believed in this formula, at any rate we were too occupied to question the veracity of this old biological axiom, and it is unknown who gave this venerable formula its dogmatic character, yet in spite of its honest intentions it has been the root of misleading and delay.

When doubts had arisen as to the truth of the formula, Pordes was the first to go into the matter, and he discovered that the law had never been recognised by any of the sciences; neither pharmacology nor biology accepted it.

We find it stated, however, that every agent whose effects are those of stimulation and growth promotion will, if given in sufficient quantities, become harmful, as per example, salt, light, food, movement, all of which are necessary to human life. Yet considerable quantities must be taken to become harmful. Inversely stated, it would not be accepted that because a small quantity is harmful it is right to assume that a greater quantity would be beneficial. Therefore, since Roentgen rays undoubtedly damage and kill cells, it does not follow that there is a quantity which produces stimulation and growth.

The step forward made by Pordes appears unimportant, yet the discovery is an outstanding one, when we bear in mind that we have been labouring for years under a false biological dogma in believing in a stimulative dose of X rays, and have credited any effect produced by small doses to stimulation and growth promotion. If we have persisted in this belief, it is because we were unaware that pharmacologists had discredited this law for the reason that they could not reconcile the law to the action of cocaine and curare, etc., as a stimulant in small doses. All agents do not stimulate in small doses, retard in medium doses and kill in large doses, but it is known that many of them are harmful in any quantity.

To what category X rays belong is a question which we must investigate; at present we can only approach it on the grounds of probability.

The records of radiology for the first fifteen years mention only the retarding and damaging effects of X rays, and these were the years when only small intensities were employed. The doctrine of stimulation only came into existence with the era of large doses. If there really exists a stimulative dose for carcinoma, then right up to 1915 we have been stimulating malignant growths; an obvious contradiction.

Even to-day there are no cases reported which are not open to doubt, and those who describe them do not venture beyond opinions, because in their statistic tables the column for "stimulated and aggravated" is absent.

If we take it for granted that X rays can stimulate the function of adult organs, such as the spleen and kidneys, then anything may be explained by it.

The Arndt-Schulz formula must be abandoned because the effects attributed to stimulation by X rays are capable of another explanation. Pordes, in his new work, refers to Stephan's book on the relief of kidney-inflammation and anuria by functional stimulation of the epithelium of the glomeruli; but let us forget this statement for a moment and ask ourselves whether this effect is capable of another explanation.

When a surgeon decapsulises a nephritic anuric kidney it resumes its function; the operation has resulted in the removal of pressure in the capsule. The cause of the anuria is due to increased pressure brought about as we know by a considerable influx of leucocytes. Leucocytes, being highly sensitive to X rays, quickly perish under radiation. But what is probably nearer to the

point is that the reduction of the pressure has been brought about by the disappearance of the infiltrate, due to decapsulation.

I have already trespassed on to the grounds of the next contribution and talked out of school.

Pordes will describe experiments, and explain results and effects which open the road to future investigation ; the way to them is simple enough so long as one keeps an unbiassed mind and does not ignore the existing reliable clinical facts.

Medical history points to the fact that truth generally lies in simplicity. The tubercle bacillus brought into existence diseases called scrofula, caries and consumption. Exanthema, gumma and paralysis resolve themselves into the primary effect of one agent, and when Roentgen medication is thoroughly understood we shall regard it as a single mechanism and not one of two contrary mechanisms.

IN EXPLANATION OF THE ACTION OF X RAYS IS IT NECESSARY TO ASSUME FUNCTIONAL AND GROWTH STIMULATION ?

By Dr. FRITZ PODES.

Summary of a paper read before the German Roentgen Society's Congress, Munich, April, 1923.

[Translated by A. E. Dean.]

It is asserted that small quantities or doses of X rays are capable of stimulating the process of development and function of living cells. This assumption emanates, as you know, from certain subjective impressions gathered from the treatment of carcinoma, but these hypotheses have never been satisfactorily proven.

This seems to be attributable in a great measure to the fetish of the Arndt-Schultz formula, which had become a dogma and an obsession.

The Arndt-Schultz formula is as follows :—

Small quantities of a medication stimulate.

Larger quantities of a medication retard.

Very large quantities of a medication destroy.

This formula, perhaps by its plausibility, had assumed the character of a biological law, and in principle it was applied to all medications and agents.

From a comprehensive review of the literature of pharmacology, the following is noteworthy and significant :—

With a large number of medications, if applied in small doses, the effect in the early stages might be regarded as stimulative.

For instance, the absorption of alcohol in small quantities produces excitation in the early stages of its effect, but this is in reality not a stimulation *sui generis*, but a quieting of consecutive sensations.

The effects appear to consist of a succession of functional disturbances, commencing with the cerebral centres, excitation giving place to the other effects, which terminate in a general narcosis. In these cases small doses act precisely as do large ones, but in a different degree.

If, therefore, opposite effects are produced by small doses, then the apparently stimulating effect is not real, but a paralysing one.

Many medications do not produce this reversal of action; small doses act on the cells in the same way as medium doses.

Strychnine in small doses raises tone.

Medium doses produce cramp and spasm.

Large doses result in tetanus.

The effect is only one of degree, the processes are the same. In the case of curare and cocaine, small doses do not produce an effect contrary to that of large ones.

I am told by a competent pharmacologist that the Arndt-Schultz law cannot be regarded as an entirely safe rule, yet medicine accepted it for years and has been influenced by it.

If then we as radiologists abandon the law, then we cannot reasonably entertain the stimulating action of small doses of X rays. It may exist, but I doubt it, and the doubt seems to be justifiable for the following reasons:—

It is well known that the cells of the human organism are dependent on the action of several agents to which the cells are accustomed, and their effect produces stimulation, as for instance light, heat, oxygen, carbonic acid, potassium, calcium, etc.; these act on the whole nature of the organ, and among them must be sought those which act directly on the cells and seem natural to them, and under certain circumstances act as cell stimulants, but even these when applied indiscriminately can become harmful and even lethal, not only to the cells but the organism.

Therefore, agents which are not natural to the cells, or inadequate agents, cannot with probability be regarded as stimulants.

Pharmacology provides other instances—curare, cocaine, strychnine. These are agents not natural to the cells and to which they are not accustomed. X rays may be considered in even a higher measure as unnatural to the cells, and exert an effect to which they cannot be physiologically accustomed, and so it is irrational to attribute a stimulating action to them.

There is, further, a series of experimental findings to hand, which were carried out on hens' eggs and seeds, but they led to nothing conclusive. All embryos possess the same common peculiarity; they have to complete certain predetermined processes of growth within a predetermined time, and an application of X rays upsets this process and results, not in a physiological gain, but on the contrary in a considerable damage and retrograde action, which may be caused by hastening of the process, but in any case it is not a real physiological stimulation, because, although the incubating period of the embryo eggs was shortened, the chicks lost their acquired strain and characteristics and cast back to the primitive type. This fact leaves food for thought as to

what might result to the human embryo if subjected to a stimulative dose of X rays during gestation.

If we irradiate eggs the incubation period is shortened and the chickens are hatched soon, but there occurs something noteworthy. Highly bred chickens, such as game fowls, lose the particularities of their strain and cast back to the commonest of types. Should these fowls be considered as physiologically improved?

More significant are the results of the experiments of Weber, who irradiated lilac buds, which came quickly to maturity but also developed necrosis and perished. In this case it cannot be admitted that there is a real stimulation; in reality the result is a complicated retrograde action, resulting in an inferior product. On fully developed organisms no information on the growth has been gained. Yet because the teaching data have been gathered from doubtful results, obtained by the use of buds and eggs, which are quite unsuitable objects for experiment, and because it is possible to hasten their growth and at the same time so adversely affect them that the final result is a deteriorated product, it has been assumed that X rays would accelerate the development of all organisms, even those of the adult human being.

No, gentlemen, the assumption of stimulation is not sufficiently proved to be accepted as a working hypothesis, and far less is it fit to be adopted as a fundamental law.

Let us for a moment consider the other aspect. It is common knowledge that X rays have the power of injuring and destroying living tissue, and in order to explain this X-ray effect, without the stimulation hypotheses, the following point must be elucidated: What is the type of cell comprised in a radiated area which possesses the highest sensitiveness to radiation and which in consequence would be the most prone to injury. Then it is necessary to ascertain the diminution or elimination of that particular type of cell, and whether its disappearance always produces the same effect. If we can do so, then X rays may be regarded as a uniform mechanism, our difficulties become lightened and chaos ended. And I think I can show by a few examples that the therapeutic effect of X rays, even those so-called stimulative, can be explained in a simple manner. Let us for a moment enquire which type of cell in an inflammatory field exhibits the greatest degree of sensitiveness; we know now that it is undoubtedly the white blood corpuscles, that the leucocyte infiltration possesses the highest degree of sensitiveness, and consequently is the first to be destroyed. It may be urged that the X-ray effect will only harm and not heal, because the leucocytes and phagocytes rally to the defence of the organism in a remarkable manner.

Yet may I refer to the views of the pathologist Lubasch, in the "Lehrbuch von Aschoff." "Nature does not in every case act judiciously. These reparative infiltrations are frequently produced in such abundance that they act oppressively on the cells of the organism, a condition termed excessive defensive reaction."

Is it not natural and probable that a series of certain X-ray effects, un-

satisfactorily explained hitherto, may be attributed to a reduction of the pressure brought about by a decrease of leucocytes due to X rays, such as, for instance, in phlegmon, erysipelas, parametritis, glandular tumour, chilblains, etc.? The removal of nephritic anuria, mentioned by Holzknecht, is also capable of the same explanation. The leucocytic infiltration of acute nephritis increases the pressure inside the kidney capsule, which pressure disappears with X-ray treatment and the function of the organ is restored, apparently just as well as with surgical decapsuling of the kidney.

Hence the theory of the resumption of function on the part of the epithelium of the kidney is extremely improbable.

Starting off with this conviction, Doctors Neuda, Kriser and myself initiated a series of experiments to establish whether X rays would not bring about a deinflammation by a reduction of leucocytes in cases of croupous pneumonia, and distinct improvement was apparent in every case observed, and what was most important was the reduction of the leucocytes in no wise adversely affected the patients; on the contrary, the reduction of leucocytes materially assisted the healing process.

Another example is that of Stephan and Fraenkel, who attribute the stimulation dose of X rays in tuberculosis to be due to the production of young connective tissue cells.

But let us argue from another standpoint. Let us enquire what cells in a tuberculosis group are most sensitive to the rays, i.e., the most readily destroyed, and again the answer will be the leucocytic infiltration, and it is common knowledge how readily leucocytes in a tuberculous area respond to X-ray treatment. The cause in all probability simply lies in the destruction of leucocytes.

The reduction in the number of leucocytes permits the free infiltration of the auto-tuberculin, producing, as Iselin states, an active auto-immunisation, and in this manner many effects resulting from X-ray therapy of pulmonary tuberculosis may be explained. The fever and local reaction which take place after each sitting may be thus explained.

The extreme sensitiveness of the leucocytes explains the beneficial results from judicious dosage, and the assumption of a stimulation dose is superfluous.

Further, why in lung tuberculosis should only those productive elements which already possess sufficient fibroblasts (connective tissue) respond promptly, whilst those which need stimulation remain so refractory?

All these manifestations are capable of explanation if the problem of the cell sensitiveness or selective action is accepted.

Without going further into the subject of unexplained X-ray effects, assumed in some quarters to be due to X-ray stimulation, may I suggest, for instance, that the accelerated passage of blood in a radiated spleen is a much simpler explanation than that of a stimulation of the function of the spleen.

Amenorrhœa, resulting from small X-ray doses, is probably due to the reduction of pressure and not to stimulation, as generally assumed, but it might

conceivably be due to an outflowing of hormones, through the destruction of the more mature of the follicles.

The results of experiments carried out in the Viennese Institute of Embryology seem to confirm in a very large measure the statements previously made.

Hitherto the recognised law of X-ray sensitiveness assumed that the cell nucleus constituted the most vulnerable part and was most sensitive to radiations, but this is not so. I can affirm that in many types of cells the X-ray disturbance will be much more active in the plasma than in the embryo. To investigate this, one must examine the condition of cells of mature organisms immediately after radiation. A safe line of experiment is to exclude, as unsuitable for experiment, all rapidly growing organisms such as eggs, buds and seeds, and devote our efforts to elucidating the different degrees of sensitiveness between cells and the components of the cells of the different organs of adult mature animals and note how and at what time after radiation the change takes place.

In conclusion, one may say that all the X-ray effects are comprehensive, if we keep in mind the different degrees of sensitiveness of the cells lying in the radiated zone; and if we investigate the result arising from the elimination of these particular cells and note the biological effects on the organ, we shall arrive at the conclusion that all X-ray reaction may be regarded as one uniform mechanism, which consistently delays real growth, and is quite irreconcilable with the hypothesis of stimulation.

FIFTH ITALIAN CONGRESS OF RADIOLOGY.

UNDER the auspices of an Honorary Committee, of which Professor O. M. CORBINI is the President, and with the support of H. E. Senatore GIOVANNI GENTILE, Minister of Public Education, the Fifth Italian Congress of Radiology will be held at Palermo on October 18, 19, 20, 21, 1923. Particulars can be obtained from the Secretary, Dott. SGROI SALVATORE, Via Alloro, 58, Palermo, Italy.

APPOINTMENT.

NEWCASTLE INFIRMARY.

At a meeting of the House Committee of the Royal Victoria Infirmary, Newcastle, Mr. R. G. E. Mortimer, Vice-Chairman, presiding, Dr. Harold Ernest Gamlen, M.B., B.S., D.P.H., a member of the Röntgen Society and British Association of Radiology and Physiotherapy, was appointed honorary assistant in the electrical and massage departments. Dr. Gamlen, who resides at Jesmond Road, Newcastle, has had considerable experience in radiology and radium therapy, and acted as radiologist to the 13th General Hospital in France, and later as a consultant radiologist to the Italian Expeditionary Force during the war.

Obituary.

It is with much regret that we record the death of Dr. Ettie Sayer on July 7th, 1923. After a prolonged period of ill health she died at the early age of 48. Members of the Section of Electrotherapeutics of the Royal Society of Medicine will remember her frequent attendance at the meeting of the Section, and the bright and vivacious manner in which she took part in the discussion and gave her experience in matters of electrotherapeutic interest.

Dr. Sayer received her medical education at University College, and at the Royal Free and Queen Charlotte's Hospitals, and in 1899 she obtained the degrees of M.B., B.S. of the University of London. After holding appointments as house surgeon to the Tunbridge Wells Ear and Eye Hospital, and registrar to the St. John's Hospital for Skin Diseases, she went to South Africa as physician to the Cowley Mission to Mahomedan and Kaffir Women, and was afterwards made plague medical officer to the Cape Government. After her return to England she was appointed assistant medical officer to the Educational Department of the London County Council, and acted in this capacity from 1902 to 1907.

Although Dr. Sayer made the practice of electrotherapeutics her specialty and conducted a successful practice in this subject, there were many other matters in which she took a keen interest and worked hard. She was a staunch supporter of women's suffrage. The welfare of feeble-minded and morally defective children occupied much of her time, and she was consulting physician to the National Society for the Welfare of the Feeble-minded. She was also a member of the Councils of the Psycho-Medical Society and of the Eugenics Society.

She was the author of a book on medical electricity and light for the use of nurses, and she wrote papers on electrotherapeutics, on the causes and treatment of inebriety, the deterioration of vision during school life, and on morally defective children. She was a Fellow of the Royal Society of Medicine and of the American Electrotherapeutic Society.

A keen and assiduous worker, Dr. Ettie Sayer never spared herself, and her untimely death will be mourned by a wide circle of friends.

NOTES AND ABSTRACTS.

Application of X rays to Chemical Analysis.—GLÖCKER (Roentgen Congress, Munich, 1923).—X-ray spectroscopy at present enables one already to obtain simple qualitative data concerning an element or elements in a compound or substance. The author relates a new research, which not only permits of qualitative estimation, but enables precise quantitative estimations to be carried out.

As an example he cites percentage estimation of the barium in a test tube to be 5.3 per cent., which was approximately that given by chemical methods, viz., 5.8 per cent. Up to a certain point intermingled foreign substances do not interfere with, nor have they any appreciable influence on, the measured result.

The nature of the chemical combination and the physical form of the material under examination is of no importance, such as saline solution, blood, etc., which adds significance to the research.

Radiographic Localisation of Spinal Lesions by Sicard's Method.—PERCY SARGENT (*Brit. Med. Jour.*, Vol. II, 1923, p. 174).—Sargent describes three cases in which the diagnosis was made by Professor Sicard's method, which consists of localising certain spinal lesions by radiography after injecting an opaque fluid into the spinal theca.

Briefly, Professor Sicard's method is as follows: A small quantity, between 1 and 2 c.cm., of lipiodol is injected into the spinal theca through a puncture in the sub-occipital region, the patient being in a sitting posture. Lipiodol is a heavy oily fluid, consisting of "huile d'oeillette" containing 40 per cent. of iodine, and is remarkably opaque to the X rays. The lipiodol sinks slowly downwards, and is arrested at any point of occlusion of the spinal theca, so that the upper limit of the tumour, for instance, can be accurately demonstrated by X-ray examination. Similarly, the lower limit of such a tumour can be shown by injecting the lipiodol through a lumbar puncture, and taking a skiagram with the patient in the Trendelenburg position.

The skiagrams of the three cases Sargent

describes were excellent, and must have been of great value to the surgeon. C. P. G. W.

A Method for the Localisation of Brain Tumours in Comatose Patients.—W. E. DANDY (*Surg. Gynec. and Obst.*, May, 1923, p. 641).—Dandy's method is to trephine over the occipital lobes of the cerebrum puncture the lateral ventricle and inject indigo-carmin. If one or two cubic centimetres of indigo-carmin are injected into the lateral ventricle, aspiration of the contra-lateral ventricle will easily indicate whether or not the two lateral ventricles are in free communication. If the dye does not pass from one ventricle to the other, there must be a tumour in the anterior or the middle and not the posterior cranial fossa. If both ventricles are dilated and the dye passes freely to the opposite side, the tumour will be in the posterior cranial fossa. Exceptions to the latter assumption are some pineal tumours and also those long-standing cases of hydrocephalus where an artificial communication between the lateral ventricles has resulted from pressure atrophy of the septum pellucidum. This dye test is also useful in deciding whether the lateral ventricles communicate with the cisterna magna or the spinal subarachnoid space. C. P. G. W.

Fractures in Transplanted Bone.—S. L. HAAS (*Surg. Gynec. and Obst.*, June, 1923, p. 749).—Haas has carried out a series of animal experiments on dogs. The bones used were the metacarpals and metatarsals. As a result of his experiments Haas came to the conclusion that fractures in transplanted bone, even when buried in muscle, united firmly and in a similar manner to a fracture under normal conditions. On the other hand, fractures in boiled transplanted bone never united or showed any signs of proliferation or attempt at repair. Occasionally a small area resembling new bone was noticed on the surface, which bore no relation to the fracture and was possibly of metaplastic origin. It was very interesting to note that fractures in transplanted bone, in which one half was boiled and the other half was alive, even when buried in muscle under favourable conditions, united. C. P. G. W.

PUBLICATIONS RECEIVED.

Books.

Light and Colour. By R. A. HOUSTOUN. (Longmans Green & Co.). 7s. 6d. net.

A System of Surgery. Three volumes. £6. (Cassell).

The Effects of Radium upon Living Tissues. By S. FORSDIKE, M.D. (H. K. Lewis & Co.). 5s. net.

Physiotherapy Technic. By C. M. SAMPSON, M.D. (H. Kimpton). 30s. net.

Lehrbuch und Atlas der Gastroskopie. By Dr. RUDOLF SCHINDLER. (J. F. Lehmanns Verlag, Munchen).

Die Röntgenbehandlung innerer Krankheiten. By F. SALZMANN. (J. F. Lehmanns Verlag, Munchen).

Atlas typischer Röntgenbilder vom normalen Menschen. By Dr. RUDOLF GRASHEY. (J. F. Lehmanns Verlag, Munchen).

Journals.

L'Actinoterapia, July 30th, 1923.

Archives d'Electricité Médicale et de Physiothérapie, June, July, 1923.

Archives de Médecine et de Pharmacie Militaires, February, March, 1923.

Archivio Italiano di Chirurgia, July, 1923.

British Journal of Surgery, July, 1923.

Bulletin of the Johns Hopkins Hospital, July, August, 1923.

Bulletin Officiel de la Société Française d'Electrothérapie et de Radiologie, June, 1923.

International Journal of Orthodontia, Oral Surgery and Radiography, July, 1923.

Journals—continued.

Journal of Laryngology and Otolaryngology, August, 1923.

Journal de Médecine de Bordeaux, July 10th, 25th; August 10th, 1923.

Journal de Médecine de Lyon, July 5th, 20th; August 5th, 1923.

Journal de Radiologie et d'Electrologie, July, 1923.

Journal of Radiology, July, 1923.

Kongresszentralblatt für die Gesamte Innere Medizin und ihre Grenzgebiete, July 16th, 23rd, 30th; August 6th, 1923.

Medical Journal of Australia, June 9th, 16th, 23rd, 30th; July 7th, 1923.

Medical Science, August, 1923.

Proceedings of the Royal Society of Medicine, August, 1923.

New York Medical Journal and Medical Record, July 18th; August 1st, 1923.

New York State Journal of Medicine, July, 1923.

Norsk Magazin for Lægevidenskaben, June, 1923.

Il Policlinico, July 1st, 15th; August 1st, 1923.

Quarterly Journal of Medicine, July, 1923.

Radiologia Medica, July, 1923.

Revue de Stomatologie, July, 1923.

Strahlentherapie, Band XV, Heft 3; Band XV, Heft 4, 1923.

Surgery, Gynecology, and Obstetrics, August, 1923.

Ugeskrift for Læger, August 2nd, 1923.

NOTICES.

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A list of collaborators at home and abroad is being prepared. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

THE CAUTERIZATION OF ADHESIONS IN ARTIFICIAL PNEUMO- THORAX TREATMENT OF PULMONARY TUBERCULOSIS UNDER THORASCOPIC CONTROL.

By H. C. JACOBÆUS, M.D.*

(From the Medical Service II of the Serafimerlasarett, Stockholm, Sweden, Professor H. C. Jacobæus, Director.)

(Reprinted, with permission, from the *Proceedings of the Royal Society of Medicine*.)

For about ten years I have been occupied with endoscopy of the serous cavities, peritoneum and pleura. At first I was interested only in the diagnostic advantages which could be gained by such a method. In a case of ascites, after tapping and replacing the fluid by air, I could by endoscopy get a clear view of the abdominal organs. There was thus no difficulty in diagnosing liver cirrhosis, malignant tumour, Pick's disease, syphilis, etc. Further, in carcinoma and tuberculosis of the peritoneum, I could see changes characteristic of these diseases. After first performing endoscopy, or laparoscopy, only on patients with ascites, I have, during the last few years, to a larger extent, also carried out the examination on patients without ascites and thereby widened the scope of the method considerably. I have further combined

* At a Joint Meeting of the Section of Electro-Therapeutics with the Roentgen Society, at Manchester, November 17th; also delivered as an Occasional Lecture at the Royal Society of Medicine, November 22nd, 1922.

laparoscopy with simultaneous X-ray examination of the abdominal organs, with the air still left in the abdominal cavity, performing the latter according to the methods of Long, Weber and others. These methods of examination complement each other in a very successful way, especially with regard to disease of the liver and the spleen and the formation of adhesions in the abdominal cavity. It is not yet possible to judge how great a value they may obtain in practice.

Without doubt, the predominant value of endoscopy centres around the examination of the pleural cavities, the so-called thoracoscopy. With regard to the chest cavity there is, as we know, nothing corresponding to exploratory laparotomy. Further, thoracoscopy is so simple a method that it can be performed without inconvenience in every exudative pleurisy which is available to a thoracocentesis. The ocular examination of the pleural surfaces is in most cases relatively complete. In cases of so-called idiopathic pleurisy I have also succeeded in finding distinct tubercles in most of them. In the differential diagnosis of tumours and pleurisy of other origin, thoracoscopy is likewise of no small value. After some practice it is at least possible, with some degree of certainty, to differentiate between tumour metastases and tuberculous changes. In doubtful cases one can by test-excision, performed with the aid of thoracoscopy, decide the nature of the pleurisy in any special case. Even solid intrathoracic tumours can be observed by thoracoscopy, and their relations to neighbouring structures, lung, thoracic wall, etc., be determined much more clearly than by any other method. By this an evident practical advantage for an intended operation is gained. As we shall see further on, this is its principal use in major surgery.

The second, and, from a practical point of view, the most important field for the use of thoracoscopy comprises those surgical operations which can be performed directly under guidance of this method. By thoracoscopy, in the pneumothorax treatment of lung tuberculosis, an especially fine picture of cord or membrane-like adhesions between lung and thoracic wall is obtained. This led me to try to work out a method of removing such adhesions as impede the treatment under the guidance of the thoracoscope. It is a well-known experience that a single cord-shaped adhesion, which attaches the lung to the thoracic wall and thereby prevents collapse of a cavity, may lead to the failure of the whole treatment in artificial pneumothorax. A recently published paper by Gravesen, from Professor Saugman's sanatorium, contains the following tables, which prove the injurious results of these adhesions:—

TABLE I.—CASES WITH COMPLETE PNEUMOTHORAX WITHOUT ADHESIONS.
(Three to thirteen years after discharge.)

Able to work	...	...	...	...	23 = 70.2 per cent
Not able to work	...	...	...	...	1 = 2.1 „
Died from tuberculosis	...	...	...	...	11 = 23.4 „
Died from other causes	...	...	...	...	1 = 2.1 „
Unknown	...	...	...	...	1 = 2.1 „

TABLE II.—CASES WITH COMPLETE PNEUMOTHORAX BUT WITH LOCALIZED, EXTENSIVE ADHESIONS.

Able to work ...	...	...	...	14 = 33½ per cent.
Died from tuberculosis	...	...	...	28 = 66⅔ „
				—
				42

TABLE III.—CASES WITH INCOMPLETE PNEUMOTHORAX WITH MORE OR LESS EXTENSIVE ADHESIONS.

Able to work ...	...	...	...	5 = 11·1 per cent.
Died from tuberculosis	...	...	...	39 = 86·7 „
Died from other causes	...	...	...	1 = 2·2 „
				—
				45

The injurious influence of the adhesions is plainly demonstrable from these tables, which also give one an impression of their frequency. I cannot here enter into the different methods attempted by others for the removal of such adhesions. I can only say that none of them has attained any practical importance.

As it was rather easy to observe the above adhesions by thoracoscopy, the idea occurred of cauterizing them by introducing a galvanocautery through another opening, under the guidance of the thoracoscope. My first attempts were made in 1913, and since then I have performed, altogether, seventy-five such operations. The operation has been further performed in more than thirty cases by Saugman; of these his assistant, Gravesen, has published sixteen. Twelve cases have been published by Holmboe and twenty more cases by Skärgård and others, six by Sömme, six by Begtrup-Hansen, three by Christoffersen, and ten by Dahlstedt. To date, certainly about 200 operations have been performed. To obviate the opprobrium that must follow failure in performance one must ascertain what cases are likely to succeed under the method and to reject those in which the operation may prove difficult or perhaps dangerous.

TECHNIQUE.

The preparations for the operation need not be very extensive. It is not necessary to give the patient morphine beforehand. If he is very anxious I find it better to give him bromide, luminal or similar remedies. One patient, in my experience, who was given morphine, had an idiosyncrasy for it, so that during or after the operation that patient became sick, and the act of vomiting set up a severe cutaneous emphysema, which developed from the puncture opening in the chest wall.

It is of the first importance to be sure that the electrical apparatus is in perfect working order.

Immediately before the operation my practice is, after the method of Saugman, to make a fluoroscopic examination and draw the points of attachment of the adhesions and their extensions on the patient's chest. This is a very good guide to the place for introducing the thoracoscope, since it is always essential to have the light as near the field of operation as possible.

The patient is placed on his healthy side with a large, hard roll-pad under

the chest as near the arm as possible, and with a smaller pillow under his head. The object of this posture is to get the pneumothorax half of the chest as convex as possible. It is also advisable to let the patient's arm on the operated side lie upward and forward, so that the scapula is pulled upward and outward. The chest wall gets thinner, the interspaces are more easily felt, and the local anæsthetic can be given with more assurance if the thoracoscope can be introduced higher up on the chest wall without difficulty.

At the operation proper I first introduce the trocar for the thoracoscope after a careful local anæsthesia, generally one to three interspaces below the level where the adhesions are marked by means of the fluoroscope. This is of course not possible if the adhesions are localized to the apex, but one has to try to find an interspace as high up in the interscapular area as possible. The higher up on the chest wall one gets the denser are the muscles and the more difficult it is to make the anæsthesia quite effective.

The thoracoscopy, which is first performed, aims at giving as complete an insight into the conditions in the pleural cavity as possible. If it is a matter of single cord-shaped adhesions, then it is rather easy. In introducing the thoracoscope rather far back near the spine, before the thicker dorsal musculature begins, one gets the longitudinal direction of the lung at right angles to the thoracoscope. In this way it is possible to get a survey of the lung in its longitudinal direction. As the adhesions generally extend from the lung to the chest wall at a more or less wide angle, it is evident that with this direction of the thoracoscope and the field of vision it will be easy enough to find and localize the adhesions in question. If the adhesions are membranous the difficulties are greater and no rule can be established, but after some practice it is in most cases possible. The same is the case if the lung is broadly attached to the anterior or posterior chest wall, and also with narrow adhesions in different directions. Only experience can solve the difficulties in such cases.

I generally introduce the trocar for galvanocautery into the lateral region, mostly perhaps in the anterior axillary line. In this way the galvanocautery is inserted in a direction parallel to the longitudinal direction of the lung and chest wall. It is desirable to be able to move the galvanocautery along the inside of the chest wall as extensively as possible. This is best attained by an incision in the lateral region where, on the whole, with regard to posteriorly and anteriorly fixed adhesions, it can be done within a less restricted area further back. With regard to adhesions which extend directly laterally, it is better to enter a little more forward, for example, in the anterior axillary line. If one enters the lateral region, it may easily happen that in handling the grip of the electric burner one's movements are hindered by the patient's hip bone.

The other stage of the operation, the cauterization itself, is then begun. It ought to be carried out with quite a weak glow, and slowly. Its difficulty is intimately dependent on the thickness and the extension of the respective adhesions and on the indications upon which the operation may be based. I, therefore, pass on to the description of the operation itself.

The galvanocautery is carefully introduced in the direction in which the

adhesion is presumed to be situated. With some experience this is fairly easy of accomplishment, and I have many times introduced the cauterizer directly on to the adhesion which I desired to burn off. If this does not immediately succeed, the adhesion has to be found with the thoracoscope in the thoracic cavity, which, to begin with, may give rise to certain difficulties. After this, the platinum point should touch the adhesion at the spot selected for cauterization. As a general rule, with cord-like adhesions, I perform the cauterization where the adhesion is narrowest. If a cavity is visible on the X-ray film, immediately below where the adhesion is fixed to the lung, the cauterization should be done as close as possible to the chest wall. Technically this is slightly more difficult, but it also causes the patient considerably more pain. In these cases the patient has a real sensation of a burning pain, which is diffused throughout the whole half of the chest. Where apical adhesions are present the pains radiate to the arm. If the cauterization is performed at a little distance (2 to 3 cm.) from the chest wall, the patient has scarcely any sensation of the cauterization, but has mostly a disagreeable feeling of traction on the adhesion, caused by the pressure of the galvanocautery.

During the cauterization itself one has to decide the intensity of the glow of the galvanocautery. This is of great importance, because of the possibility of hæmorrhage. After switching on the current, it ought to take five to ten seconds before the platinum needle becomes aglow, and then there should be only a red glow. A white heat is absolutely contra-indicated. Sometimes I have allowed the platinum needle to glow in the pleural cavity and then applied the glowing needle to the adhesion. At other times I have first placed the needle over the adhesion and then switched on the current. The difference is that in the latter case one obtains a considerably slower heating of the needle. There is no great difference between these two methods.

The cauterization should proceed very slowly. In slightly pressing the galvanocautery against the adhesion one feels how fibre after fibre is loosening. Then, bit by bit of the adhesion can be burnt off, until at last it is completely severed, when the lung collapses by its own weight, and usually a space of several centimetres appears between the two burnt off stumps of the adhesion.

As above mentioned, the danger of cauterization is hæmorrhage. On the one hand, it is possible to encounter such large vessels in the adhesions that even under cautious cauterization hæmorrhages occur. This difficulty has scarcely been solved. Forlanini and Permin state that upon section they have found veins the thickness of a quill in adhesions and on the pleural surfaces. I, myself, have seen varicose veins on the surface of the adhesions, but not of such thickness. Not infrequently I have burnt off such small veins without hæmorrhage. Whether the larger veins also imply any more serious danger of hæmorrhage, I am, of course, unable to decide from my own experience. In my opinion these vessels are not the most dangerous. The pressure in them is certainly very low, and if, in case of hæmorrhage, a saline solution is injected in sufficient quantity, the hæmorrhage should in all probability cease before it becomes dangerous to life.

It is my belief that it is only when an artery is burnt right through that hæmorrhages really dangerous to life are to be expected. Whether such are to be found in the adhesions also is not fully clear. The only microscopic investigations of cord-like adhesions, which have been made to any large extent, are those which I carried on some years ago. In them are to be found vessels, the nature of which cannot be decided. They have a very thick musculature; so thick that sometimes obliteration ensues. Cauterization of such vessels surely does not cause any hæmorrhage dangerous to life. The retraction of the adhesion which sets in after the cauterization should certainly entail a further shrinkage and probable closure of the vessel.

The danger of a very serious hæmorrhage arises if during cauterization the lung is penetrated and an artery severed. Here there is neither any hypertrophy of musculature of vessel wall, nor is any considerable retraction of the surrounding tissue to be expected. This is accordingly the principal danger which threatens in the field of operation.

Only once have I experienced hæmorrhage of any consequence. In this case there was quite a narrow thread-like adhesion. The cauterization was carried out very easily and quickly, in a fractional part of a minute; but afterwards blood escaped rather rapidly in drops from the parietal stump of the adhesion. In all, the hæmorrhage might be estimated at the most to have been about 200 c.c. My impression is that there was too strong a glow of the galvanocautery. Other authors, such as Saugman and Skärgård, have at times had smaller hæmorrhages, which were considered to be caused by too strong a glow, at least by the latter operator.

Only once, in all the operations known to me (so far in more than 100 cases), has a fatal hæmorrhage ensued. In one case, where the operation, performed by Doctor Dahlsedt, proceeded quickly, a severe hæmorrhage suddenly set in. The blood spurted into the thoracic cavity. The prism of the thoracoscope became constantly splashed, and it was therefore impossible, under its guidance, to get at the bleeding point with the galvanocautery in order to stop the bleeding by means of a fresh cauterization. The bleeding became so severe that the patient lost consciousness. Things began to look very threatening. The very circumstance that the burning immediately before the catastrophe proceeded so quickly is an indication that too strong a glow of the platinum needle had been used. In another case, where the operation was performed by Skärgård, a similar arterial hæmorrhage arose from the lung. Here the operator succeeded in stopping the bleeding by continuing to burn the bleeding part proximally. This method is indeed very daring, but it partly shows that the bleeding really comes from a pulmonary vessel and partly that mere chance is probably a causal factor, because it is more likely that the bleeding vessel was still thicker at the last cauterization. I myself have stopped quite small hæmorrhages by holding the galvanocautery close to the bleeding point. Should a large arterial hæmorrhage arise, I think it best to get as high a pressure as possible in the pleural cavity in question. The best

method to obtain this end should be to fill it up with saline solution, which ought to stop the hæmorrhage.

My conception of the cause of the hæmorrhage and its prevention is that :—

1. The severer hæmorrhages probably, and, if so, principally arise from cauterization of the lung itself.
2. They can most effectually be prevented by using a weak glow and by burning as slowly as possible.

In previous papers I have, from a practical point of view, classified the adhesions into three different groups : (1) Apical, (2) lateral, and (3) diaphragmatic. The limit between at least the first two classes is rather vague, and I have, therefore, fixed the second rib as the line between them.

The commonest belong to Group 2, the lateral adhesions. Of my fifty cases, forty-five belong to this group. Some of them border on Group 1, where we thus find the largest and thickest adhesions below the second rib, and some smaller cord-like ones higher up in the dome of the diaphragm itself. Or we find membranous adhesions, which continue toward the apex above the second rib. The reason why I have separated an upper group is on account of the more difficult technique which is required for apical adhesions. The technique of these cauterizations has for its object the introduction of the thoracoscope as high up as possible in the back, after the scapula has been pushed upward and forward. Others, for example, Skärgård, have found it suitable to insert the thoracoscope in front or in the axilla. It is possible that this technique is convenient for certain cases of adhesions to the anterior part of the chest wall, but I have no experience of this.

The difficulty in cauterizing these adhesions lies in the following circumstances. Most cavities occur in the apex of the lung, and these are attached to the dome of the diaphragm itself by short adhesions. The mobility of the lung in respiration is here rather limited, and from this it follows that these adhesions during life are exposed to relatively little tension and are therefore short, consequently there is a risk of burning the lung. At all events, it is necessary to burn as close to the chest wall as possible, which often causes this operation to be rather painful. In this group I have had two peculiar cases, in which the operation went well and the condition of the patient obviously improved, but after one or two months the patient suddenly fell ill with acute empyema, in one case with a mixed infection. The question arises whether the cauterization of rather large adhesions has had any unfavourable influence, and whether a rupture of the lung has taken place in some weak point, where the burning has been performed, or whether it has set in quite spontaneously. I cannot give any answer to this, as I have not had the opportunity of seeing any autopsy. I wish merely to draw attention to it.

The lateral adhesions from the area below the second rib to the diaphragm are the most numerous. They are mostly quite easy to reach. If they are attached wholly in the lateral region, difficulties may sometimes arise; in this respect, that if the burner is also introduced into the lateral region, the hip

bone may, as already mentioned, get in the way of one handling the burner with one hand. In such a case the best to do is to introduce the trocar for the burner either further forward or further backward.

Diaphragmatic adhesions also deserve closer consideration. In all my cases of this kind it has happened that the lung above has been attached to the chest wall to such an extreme degree that it has not been possible to undertake any cauterization there. Besides, there have been present narrow, cord-shaped adhesions to the diaphragm—sometimes only one, sometimes many. By burning them off it is possible to get the lung pushed up and thereby also to obtain a more complete collapse of the lung. From a technical point of view, the cauterization presents the difficulty that the patient must hold his breath during the operation, as, otherwise the adhesions are in constant movement. If the cauterization succeeds in a single burning there is no difficulty; but if, as is generally the case, the galvanocautery has to be applied several times on this swinging band, it can be ever so troublesome technically to remove such adhesions. One advantage is that the cauterization of such adhesions is completely painless. Another question is the practical use of such cauterizations. In my opinion, it is only in exceptional cases that there is any real benefit to be obtained by them.

It is necessary before each cauterization to have an X-ray photograph of the collapsed lung with its adhesions. The first question that arises is, then, how much can be judged from the X-ray picture as to the prospects of a successful operation? In cases where only one or two isolated, cord-like, long adhesions are to be found, the indications are easy, and one can assume at once that from a technical point of view it is possible and very likely easy to cauterize the adhesions. It is more difficult to decide those cases in which the X-ray apparently shows too thick adhesions, or in which the surroundings are quite indistinct, and one does not know the nature and extent of the adhesions. In the latter case one has to rely on the thoracoscope. In some cases the X-ray picture has been misleading with regard to the possibility of cauterization, for from it one obtained the impression that the lung was held expanded by a thin membrane, which could easily have been burned off. In one case the lung was broadly attached to the posterior chest wall, and what looked like an adhesion was only a protruding fold from an area where the surfaces were matted together. The cauterization in the latter case consequently did not succeed. This state of affairs ought to be discovered, or at least suspected, if an X-ray picture is taken both from front and back. More and more have I found that if seemingly string-shaped adhesions exist near the anterior or posterior chest wall, they are seldom free, but are attached to the chest wall throughout their length. The result of cauterization in such cases has been only the removal of the more protruding folds, while the larger part of the adhesion remained.

Undoubtedly the best procedure in such cases is stereoscopic X-ray examination, which has been practised in our hospital only a few weeks. This method should also be of the greatest importance in the localization of other

adhesions and their disposition in the pleural cavity. I believe, however, that in one respect its value is subject to certain limitations, which are inherent in the ordinary X-ray picture, which usually shows too few adhesions. I can state that in the majority of the cauterizations there have always been found more adhesions than were visible in the X-ray picture. This is generally of less importance, because the unobserved adhesions are, as a rule, so thin that they do not present any serious obstacle to cauterization.

Experience shows, however, that cauterization in most cases is more difficult than can be expected from the X-ray picture. In one of my cases the X-ray showed very different conditions from what were actually found. It was a case sent to me for cauterization of a dense adhesion at the apex. From the X-ray photograph cauterization seemed possible, but thoracoscopy made it evident that the adhesion was so dense that I would not even attempt cauterization. The patient was referred to Dr. Key for a plastic operation of the thorax. On account of the apparently limited thickness of the adhesion, visible by X-ray, Dr. Key attempted thoracotomy in the first interspace, with dissection of the adhesion, as in a previous case published by us jointly. But the adhesion was too dense even for such an operation, since it filled nearly the whole apex. Later, a thoracoplasty was performed. This case is not unique. Both from the literature and from private information I have become familiar with cases in which attempted thoracotomy has shown the adhesions to be much thicker than was originally supposed. In these cases the operation was consequently more difficult, and involved more extensive interference than had been anticipated, and in the majority it had the very serious sequel of tuberculous empyema, with or without mixed infection.

The other method to determine the possibility of operation is thoracoscopy. This will, according to my opinion, become more and more important in deciding the possibility of operation in the more serious cases, not only with regard to cauterization but also to other surgical methods.

By thoracoscopy one gets a perfectly accurate picture of narrow, cord-like adhesions, up to the thickness of a small finger. The difficulties appear in the case of membranous adhesions and those attached to the surface.

(To be continued.)

ROENTGEN RAY STEREOSCOPY.

By ROY KEGERREIS, Physicist, Mayo Clinic, Rochester, Minn.

VISION with two eyes enables us to see things in three dimensions. The view which one eye gets differs from that of the other; the brain co-ordinates these two groups of sensations and we see things as a unit of three dimensions or in stereo. Experience enables this to be done easily and renders it needless for sensible effort to be applied as long as we look at familiar scenes.

In roentgen ray work we are in reality looking at the unknown, or at the familiar in an unfamiliar way, and for that reason secure much benefit from stereo views. The roentgen ray localises objects as well as places them in perspective. For instance, certain types of fractures are much more readily detected in stereo than otherwise, as are, also, abnormalities of the chest.

The eye is a marvellous achievement in biological specialisation, yet the normal eye is a very imperfect optical instrument. The retina upon which the image is projected is not equally sensitive throughout. Just one area, not much larger than a pin head, is of extreme sensitiveness; this fovea or yellow spot clearly resolves images. When we look at something we see only a very small part clearly at any one instant, while the remainder is outlined by a blurred mosaic. The retina is a spherical surface with its centre at the centre of the eye, which makes it impossible that its entire area be in focus. This does however give some power for securing a measure of depth. A photograph is unlike this, and to a very marked extent does not represent the object as it appears to the eye; in fact, a photograph is a very poor delineation of the subject.

When we look at an object the laws of perspective are obeyed; the parts nearest the observer are most clearly outlined and appear the larger, while the more remote parts are foreshortened and dimmer. These conditions are not duplicated with roentgenograms, where a shadow picture of the object is projected on a screen or photographic surface. The parts nearest the target of the tube are blurred and magnified the most, whereas the regions nearest the screen are the most clearly outlined and magnified the least (Fig. 1). This is an unalterable defect which is inherent in roentgen ray work and should be clearly recognised. It is largely caused by the finite size of the target. The smallness of the focal spot is limited, since the power of the tube is diminished as the area of the focal spot is decreased. The milliamperesecond output for each unit area of focal spot is limited and cannot be exceeded safely.

There is a certain limit to the attainable contrast in roentgen ray work; the physiologic processes of stereo vision function best where vivid contrasts prevail, as for example the sunny scenes of ancient Pompeii, which were always included in the stereoptican sets of a generation ago. It requires training and effort to acquire the ability of getting the images to melt together and readily seeing stereo when viewing roentgenograms.

Stereo views are obtained by taking two pictures of the subject, the tube having been moved about six centimetres between exposures (Fig. 2). There are, however, rather wide tolerances through which the shift may vary.

Roentgen ray plates are usually viewed in some kind of stereoscope, the Wheatstone type being the most common. The plates should be marked so that they may be easily placed in the holder in the proper manner. There are one hundred and twenty-eight different ways that two roentgen ray plates may be put in a stereoscope. Each plate may be put in its holder on one side in four ways with the emulsion side front, and four ways with the emulsion

side back. The other plate may be placed in each of its eight different ways for each one of these eight ways; that gives sixty-four combinations. The plates may be interchanged for each of these sixty-four positions, from right to left, thus accounting for the one hundred and twenty-eight combinations. Four of these one hundred and twenty-eight possibilities give true stereo vision, the object appearing in its normal dimensions (Figs. 3, 4, 5, 6). Four other combinations give pseudo-stereo vision (Figs. 7, 8, 9, 10). The small view which is depicted with each pair of stereo views gives a representation of what is seen when looking at the plates in a stereoscope. It will be noticed among these eight combinations that an even number of malmanipulations of the plates give true stereo and an uneven number give pseudo-stereo effects. The distinction between stereo and pseudo-stereo are niceties which in practice matter little, since the anatomy of the human body is known so well.

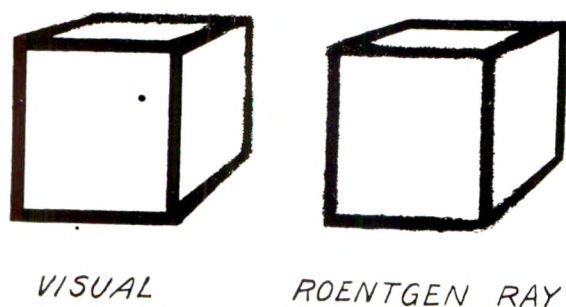


FIG. 1.

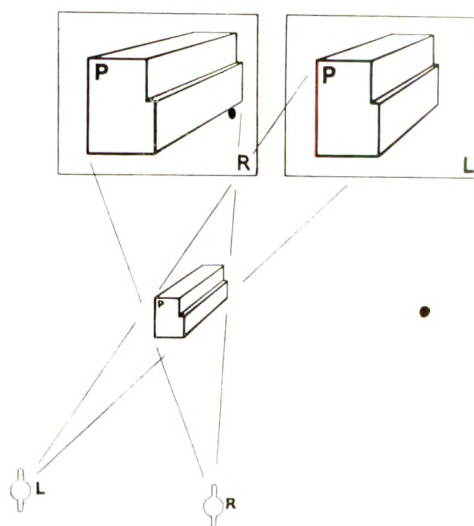


FIG. 2.

The late Professor Van Zualenberg modified the Wheatstone stereoscope by placing the two-mirror wedge with its edge horizontal, like the roof of a house. His arrangement has the distinct advantage that two people may simultaneously view the plates in stereo. It is surprising to many that each of the two observers sees exactly the same thing in the same way. This illustrates one of the peculiarities of stereoscopy. The thing which takes the picture determines the view point and, accordingly, what is seen—not the position of one's eyes when looking at it. Looking at any picture from different angles does not in the slightest alter what is seen.

It has been found that the stereo effect is enhanced if vivid contrasts are effected. It is for that reason that the tube is moved perpendicular to the ribs when taking stereo views of the chest.

Good judgment in selecting the relative position of the part to be rayed and the direction of tube shift can only be gained by experience. Mechanical contrivances have been devised to shift the tube and plate holders auto-

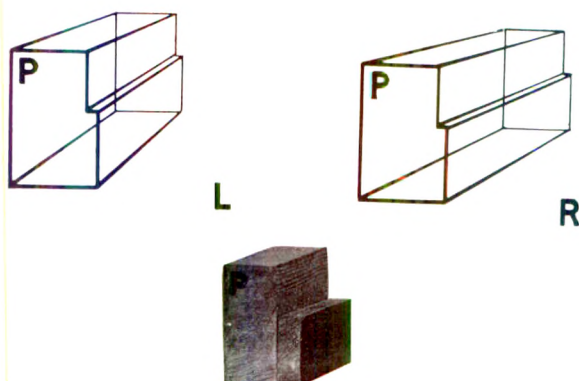


FIG. 3.—Real view (correct).

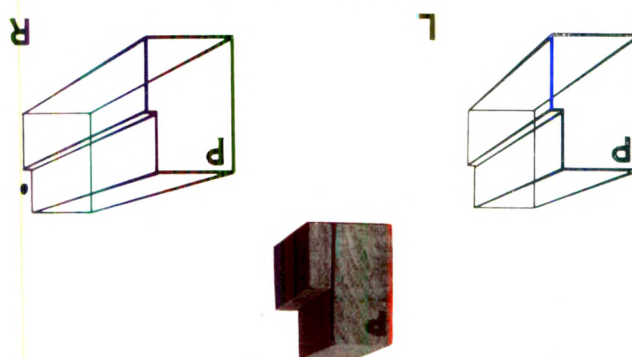


FIG. 4.—Real view. Right and left reversed. Both upside down.

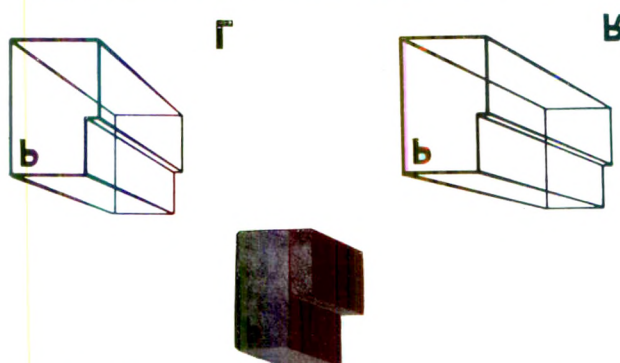


FIG. 5.—Real view (mirrored). Film side back. Both upside down.

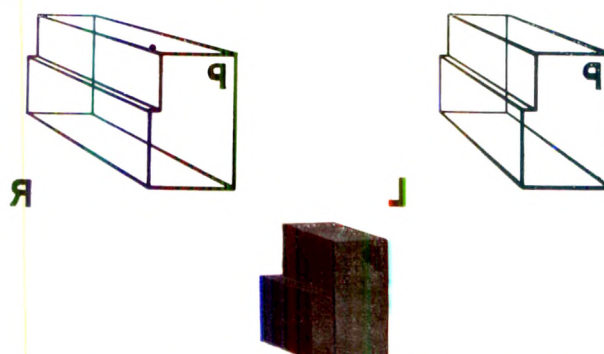


FIG. 6.—Real view (mirrored). Right and left reversed. Film side back.

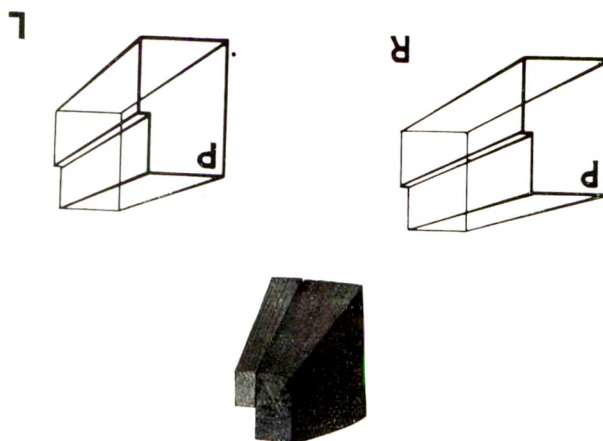


FIG. 7.—Pseudo view. Both upside down.

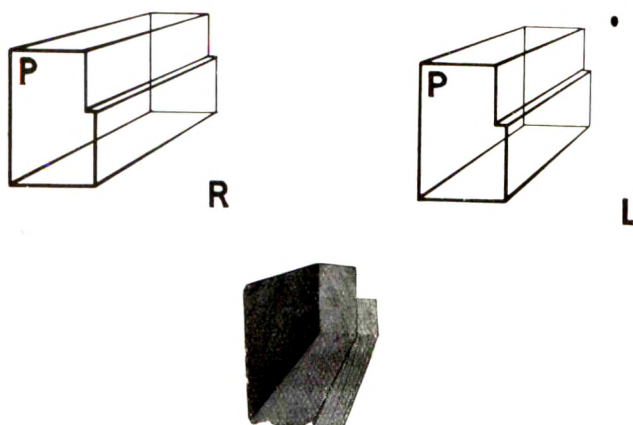


FIG. 8.—Pseudo view. Right and left reversed.

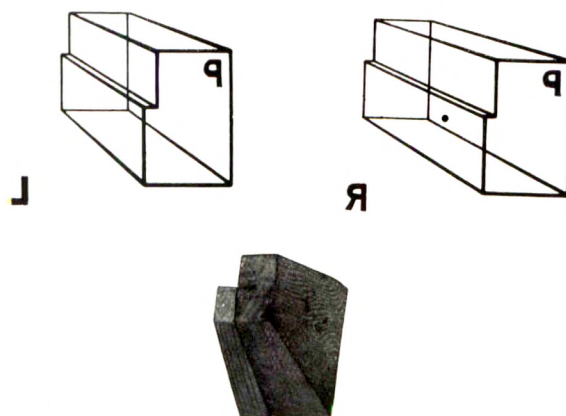


FIG. 9.—Pseudo view. Both film side back.

matically. The time period required for both the shift and the two exposures has been lowered to well under a second in special cases.

Schemes for viewing in stereo by means of fluoroscopy have been perfected. Two tubes, or a duplex tube with two targets, are used. A transfer device causes the two targets to function at alternate periods, while a synchronously driven sectored screen allows the two eyes to see alternately. The effects attained are very desirable, but the mechanical complication is such that it will probably never be universally used.

It is very seldom that a person's two eyes are alike, the strain in securing stereo vision may be diminished by varying the brightness of the screen towards which one of the eyes is looking.

The primary reason for localisation is as an aid to surgery. Specification of the exact location of a foreign body is one thing, and its surgical extraction is another; the latter needs correlating information. It is much more

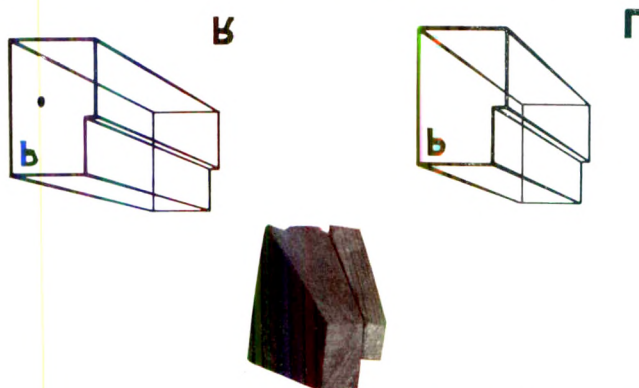


FIG. 10.—Pseudo view. Right and left reversed. Film side back. Both upside down.

desirable to know approximately where the foreign body is when the operation is begun, and exactly where it is as the operation progresses, than to know exactly at the start and only approximately as the work progresses. It is this condition which in large part mitigates against elaborate methods for locating foreign bodies, but makes a crying need for some means of keeping track of the foreign body while the operation progresses, if such a scheme is used.

Arrangements have been devised whereby the surgeon may view the patient by means of roentgen rays while the operation is in progress. Such methods have the distinct handicap that the illumination must be very dim, or considerable intervals must elapse between work with and without roentgen rays. In reducing fractures, however, the dim illumination does not hinder the surgical work.

ELEVATION OF THE DIAPHRAGM. UNILATERAL PHRENIC PARALYSIS. A RADIOLOGICAL STUDY, WITH SPECIAL REFERENCE TO THE DIFFERENTIAL DIAGNOSIS.

By J. M. WOODBURN MORISON, M.B., C.M., Hon. Assistant Radiologist, Royal Infirmary, Manchester; Lecturer Applied Anatomy—Radiological, Manchester University.

(Continued from August issue, p. 83.)

DIFFERENTIAL DIAGNOSIS.

We have seen that elevation of the diaphragm may be permanent or temporary, and that permanent elevation may be congenital or acquired.

Temporary elevation of the diaphragm frequently occurs, and is caused by gaseous distension of the air sac of the stomach. In children it is not uncommon to see the left side of the diaphragm raised well up into the thorax, and to find on the following day that it is quite normal in position.

In adults it is often present in pathological conditions of the stomach, particularly in carcinoma. It is usually associated with the "cup and spill" or "cascade" type of stomach. Temporary elevation is easily differentiated from permanent by the screen examination. The movements of the affected leaflet are never reversed; they may be limited in extent, but they are always synchronous with the other half of the diaphragm; in other words, there is no paralysis.

The two following cases are typical examples of this condition:—

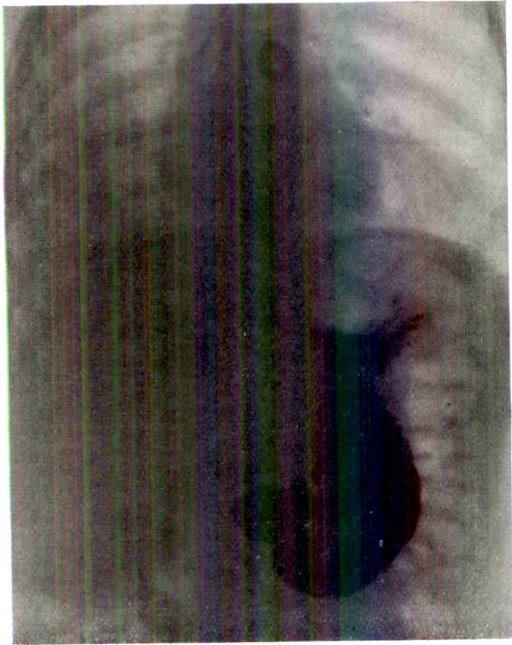
GROUP III.

CASE 1. A case of temporary elevation in a child of five years of age. On the following day it was quite normal. All the usual radiological signs of elevation were present, but the movements of the bow line were synchronous with those of the other half of the diaphragm.

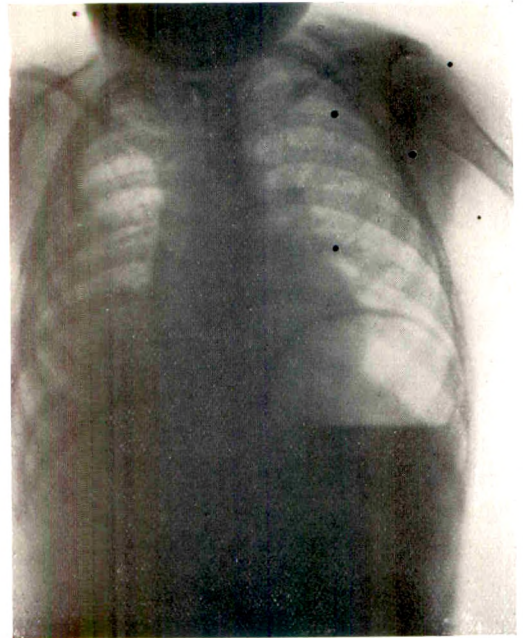
CASE 2. H. P., male, aged 60. A case of carcinoma of the pyloric end of the stomach. The left side of the diaphragm was elevated, but the movements were regular and in unison with those of the right. The stomach was of the cascade type.

Permanent elevation of the diaphragm may be congenital or acquired, and we have noted that these types present many radiological features in common; in fact, that Petit's eventration and unilateral phrenic paralysis are clinically and radiologically indistinguishable, apart from the presence of a definite pathological lesion involving the phrenic nerve. In some cases it may not be possible to demonstrate such a lesion, and these cases have been classified as congenital in origin. In the case of A. O'B. (Group I, Case 1) I obtained graphic records of the movements of the chest wall. As previously recorded, these showed almost entire absence of movement over the lower ribs and the apical region of the affected side. Dr. M'Swiney and I have obtained graphic records of the movements of the chest wall in other cases of elevation of the diaphragm. We find two distinct types:—

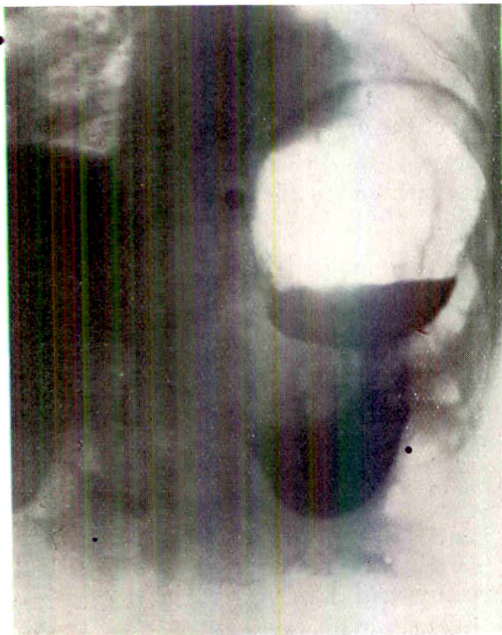
1. Cases similar to the one recorded above.
2. Cases in which opposite results were obtained, the movements of the chest wall on the affected side being if anything increased.



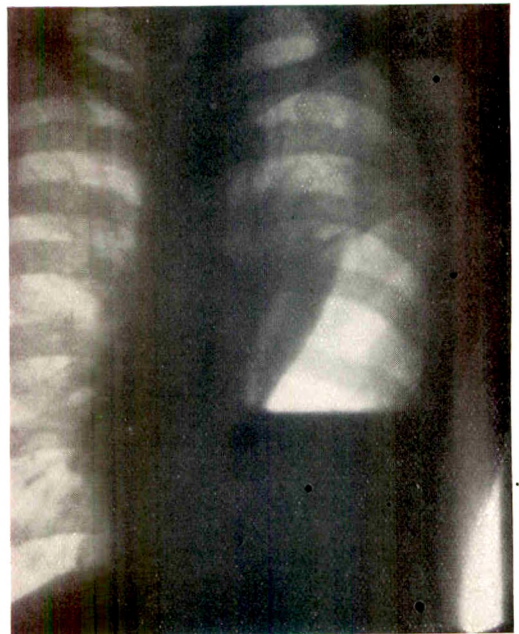
GROUP III.—Case 1. The day following.



GROUP III.—Case 1. Child aged 5 years. Temporary elevation of the diaphragm.



GROUP III.—Case 2. H. P., male, aged 60. Temporary elevation of the diaphragm. Note "cup-and-spill" stomach.



GROUP IV.—Case 1. H. D., male, aged 26 years. Upright position. Extensive diaphragmatic hernia.

In the first type we suggest that there is a congenital unilateral paralysis of the diaphragm, associated with hypoplasia of the left lung. In the second type we suggest that there is an acquired unilateral paralysis of the diaphragm, even though there is no visible pathological lesion of the phrenic nerve. Assuming that the lungs were fully developed at birth, and that the paralysis occurred during adult life, the movements of the chest wall would be accounted for by the expansion of the lungs. One of the principal actions of the diaphragm is to elevate the lower ribs during inspiration, and we advance proof that in conditions where there is lack of development of the diaphragm at birth, there is also loss of movement of the chest wall at the base and apex of the lung on the affected side. In conditions where paralysis of the diaphragm occurs in the adult, movements of the chest wall are not lost; this is due to the expansion of the normal lung associated with the use of the extraordinary muscles of respiration.

By recording the movements of the chest wall, and by the radiological study of these cases, it is possible to differentiate acquired from congenital paralysis of the diaphragm.

We have further to differentiate permanent elevation of the diaphragm from other diaphragmatic conditions, such as in Group IV:—

1. Diaphragmatic hernia.
2. Localised hydro- or pyo-pneumothorax.
3. Sub-phrenic or sub-hepatic abscess.

DIAPHRAGMATIC HERNIA, ETC.

Diaphragmatic hernia may be congenital or acquired. The congenital defects in the diaphragm were thoroughly investigated by Sir Arthur Keith, and recorded in the *British Medical Journal*, October 29th, 1910. If his diagram is taken in conjunction with another diagram by Broman, representing the development of the diaphragm, it is at once seen how these cases occur. So far I have not had the opportunity of observing this type of case. I understand, however, that they are not uncommon. Dr. Campbell Suttie, of the Royal Hospital for Sick Children, Glasgow, in writing to me states that this is his opinion. He has seen three cases within two years.

A congenital weakness, however, may exist during life, inviting a hernia, and in one case which I record a large diaphragmatic hernia occurred without any definite trauma.

In diaphragmatic hernia we place those cases in which there is a prolapse of viscera into the pleural cavity through a gap in the diaphragm. The X-ray examination shows an elevated irregular broken line extending across the hemithorax, which can hardly be mistaken for the diaphragm. Lung tissue may or may not be seen through the air underneath this line; the fluid contents of the stomach may reach high above the level of the cardiac orifice, and rippling on the surface is easily produced by palpation of the abdomen. If

the hernia be a small one the reversed movements of the hernia during respiration are well seen, but if the hernia be extensive no movements may take place.

The presence or absence of the colon has also been stressed as a diagnostic point. In eventration it may be absent or present on different examinations of the same patient. In hernia the same observation holds good, although it is practically always present at operation, but then the conditions have been altered by the opening of the abdomen or chest, the opening in the diaphragm appearing much larger than the X-ray examination would lead one to expect.

The examination of the stomach by means of a bismuth meal is of the greatest importance and should rarely fail to settle the diagnosis.

In localised hydro- or pyo-pneumothorax, and in sub-phrenic and sub-hepatic

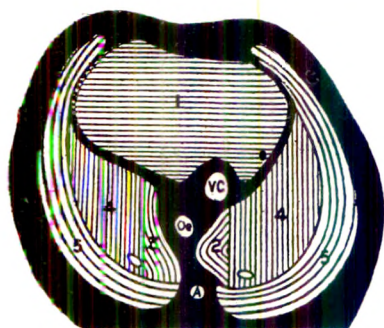


FIG. 198.—Diagram showing the origin of the diaphragm (after Broman). 1, Septum transversum; 2, 3, derivatives of mesentery; 4, 5, derivatives of pleuro-peritoneal membrane; 6, parts derived from the body wall; A, aorta; Oe, esophagus; VC, inferior vena cava.

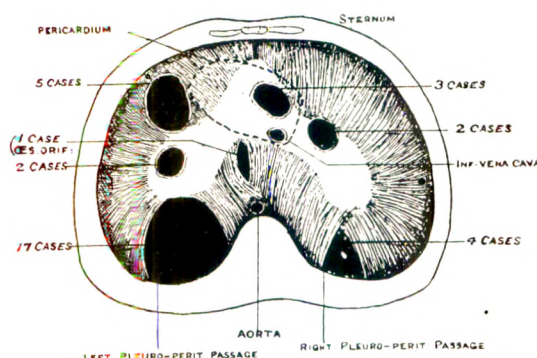


FIG. 1.—Diagram to show the sites of diaphragmatic hernia, as deduced from 34 museum specimens in London. The upper or thoracic aspect of the diaphragm is represented.

(After Keith)

These diagrams, studied in conjunction, show how congenital defects in the diaphragm occur.

abscess, there is usually little difficulty in establishing a diagnosis. The following are illustrative cases:—

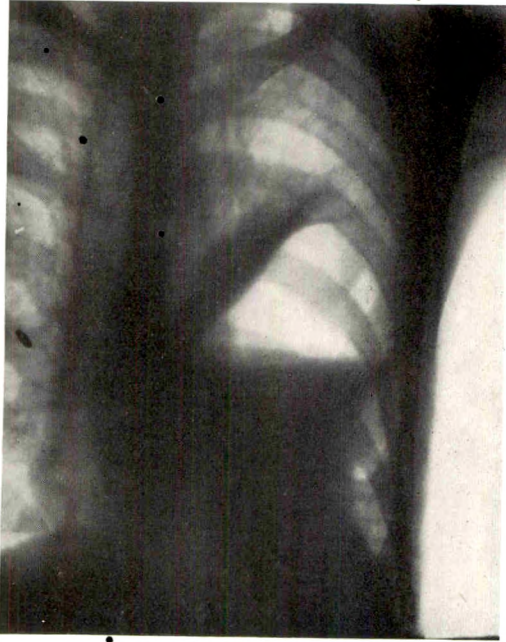
GROUP IV. RECORDS OF CASES.

CASE 1. H. D., male, aged 26. There was no history of any injury. The physical examination gave all the signs of a hydro-pneumothorax. The screen examination showed the dark line of fluid extending right across the left side of the chest with a clear air space above it—the air space extending to the height of the second rib in front, the fluid to that of the fourth. A portion of collapsed lung was noted through this clear air space. No lung tissue was seen apart from the collapsed lung. There was no definite bow line observed and no paradoxical respiratory movements.

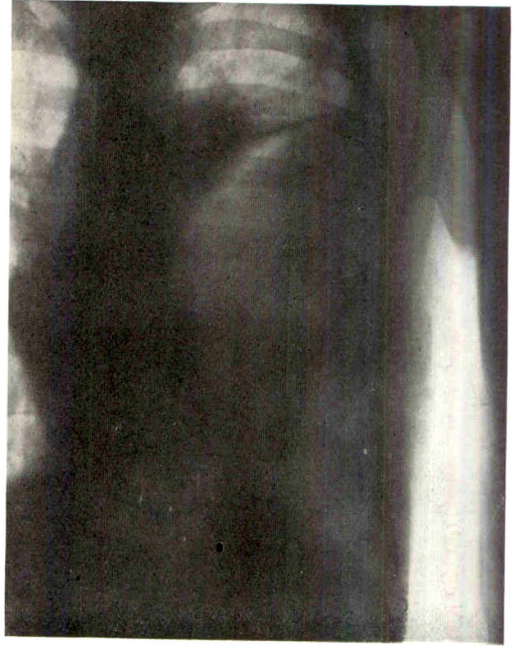
Palpation of the abdomen produced ripples on the surface of the fluid. The appearances were quite typical of a hydro-pneumothorax. At a later examination, however, the splenic flexure was seen rising up alongside the fluid to a height, apparently, slightly above it.

At operation it was found that there was a large rent in the posterior wall of the diaphragm, and that practically the whole of the stomach and a large portion of the colon were in the chest.

CASE 2. J. S., male, aged 40. This was a definite case of hernia of the left leaflet of the diaphragm, due to a gunshot wound. The X-ray examination of the chest showed an irregular



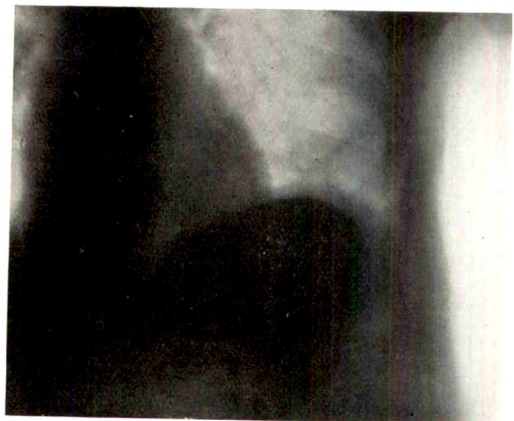
GROUP IV.—Case 1. Upright position. Note the presence of the colon on this occasion.



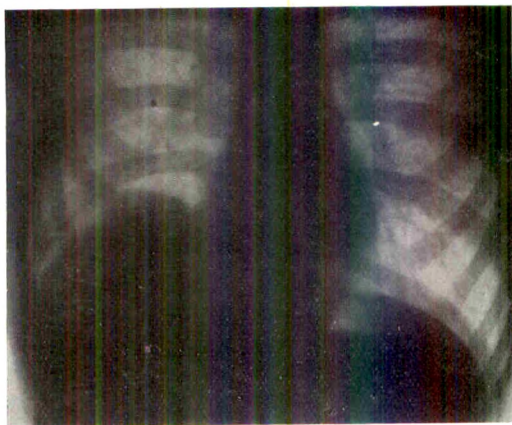
GROUP IV.—Case 1. Lying down position.



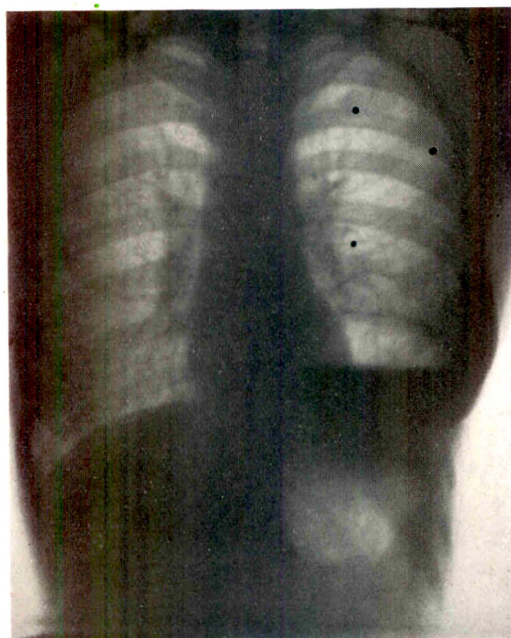
GROUP IV.—Case 2. J. S., male, aged 40 years. Lying down position. Diaphragmatic hernia.



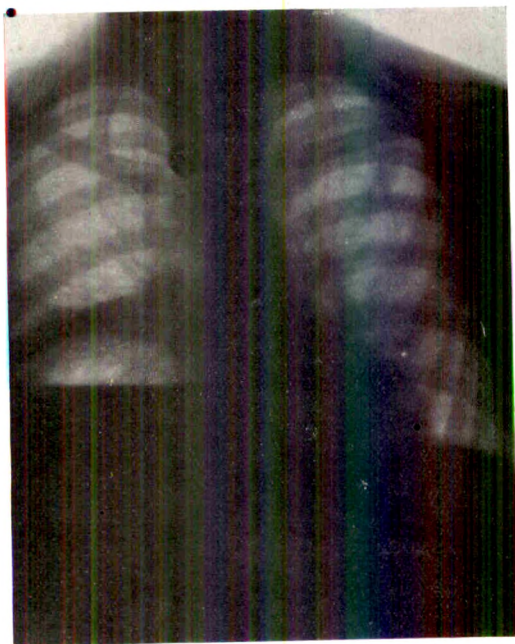
GROUP IV.—CASE 2. After operation.



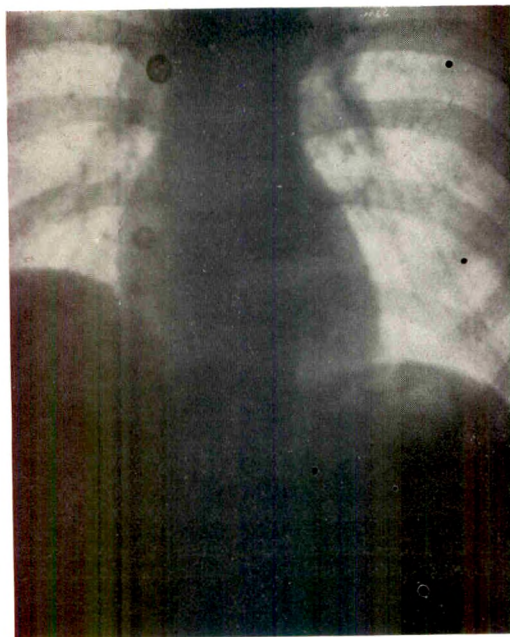
GROUP IV.—Case 3. T. B., male, aged 30. Diaphragmatic hernia—right side.



GROUP IV.—Case 4. Girl, aged 13 years. Localised hydro-pneumothorax.



GROUP IV.—Case 5. G. O., male, aged 16 years. Sub-phrenic abscess.



GROUP IV.—Case 6. W. S., male, aged 30 years. Sub-hepatic abscess.

line on the left side, the inner portion of this irregular line being diaphragm—the outer part stomach. The movements were plainly seen on the screen, and one could see the inner half moving downwards while the outer half moved upwards. The bismuth meal examination very definitely established the diagnosis, for with the patient lying down one was able to run the bismuth backwards and forwards through the opening in the diaphragm and watch the herniated portion of the stomach filling and emptying. This was done by tilting the table top during the examination.

The approximate size and position of the tear in the diaphragm was ascertained, and it is interesting to note that the colon was not seen forming part of the hernia during the X-ray examination.

At the operation by Mr. A. H. Burgess, of Manchester, the abdomen was opened, and it was found that the outer and posterior part of the diaphragm had been torn from its attachments. Both the stomach and colon formed part of the hernia.

The diaphragm was repaired, and later on an X-ray examination showed the result to be excellent.

CASE 3. T. B., male, aged 30. *Hernia of the right side of the diaphragm* due to a gunshot wound—France, 1914. The right side of the diaphragm was fixed, but the liver shadow was seen to be elevated—reversed movements.

CASE 4. Girl, aged 13. *Localised hydro-pneumothorax*. This case was seen one year after operation for empyema. The girl was in excellent health and doing light house work. There was a localised hydro-pneumothorax present. The line of fluid was above the level of the cardiac orifice, and each heart beat produced waves along the surface of the fluid.

The position of the diaphragm was easily ascertained by giving a seidlitz powder.

CASE 5. G. O., male, aged 16. *Sub-phrenic abscess*. In this case a sub-phrenic abscess developed three weeks after operation for acute appendicitis. The appendix was retrocaecal and gangrenous, and an abscess was present which was drained. Further trouble developed, however, and at the X-ray examination the right half of the diaphragm was found elevated and fixed, with a clear air space underneath, at the lower border of which was a straight line of free fluid. Splashing of the fluid was easily produced, and in the recumbent position the air was displaced, the fluid running up into the chest to the level of the bow line. The lower margin of the liver was pushed downwards.

At the operation a sub-phrenic abscess was found containing a large quantity of foul-smelling pus.

CASE 6. W. S., male, aged 33. *Sub-hepatic abscess*. On the 22nd of February, 1923, this man was operated on at the Manchester Royal Infirmary for an acute appendix. A perforated appendix was found associated with an abscess. He progressed quite satisfactorily and was discharged on the 28th of March, 1923. He was re-admitted on the 13th of April, 1923, and the X-ray examination showed elevation of the right leaflet of the diaphragm and the liver. There was no fluid detected and no separation of the diaphragm from the liver. No movements of the elevated diaphragm and liver were detected.

At the operation a large sub-hepatic abscess was found and drained.

CONCLUSIONS.

1. Petit's *eventratio diaphragmatica* and unilateral phrenic paralysis are not so uncommon as is generally supposed. Radiographically they present similar features.

2. There is evidence, in a study of the cases presented, and in the literature, that Petit's eventration may be due to :—

(a) A developmental defect in the muscular tissue of the diaphragm.

(b) An injury to the phrenic nerve at birth.

3. At first these conditions formed a purely pathological study ; it is now possible, with the advancement of radiology, to observe and diagnose such cases clinically.

4. Many of these cases have exhibited gastric symptoms, and I would draw special attention to the deformity of the stomach due to mechanical causes which I have described. It should be noted that this deformity may become a condition requiring surgical interference.

5. The diagnosis, from the radiological standpoint, rests mainly on :—

- (a) The unbroken bow line extending high up into the thorax with its reversed movements, unless adhesions have formed.
- (b) The level of the free fluid in the stomach is that of the cardiac orifice.
- (c) The bismuth meal examination.

LITERATURE.

- 1774. Petit, "Traité de maladies chirurg." 1st Edition.
- 1780. Petit, "Traité de maladies chirurg." 2nd Edition.
- 1790. Petit, "Traité de maladies chirurg." 3rd Edition, Vol. II, p. 234.
- "Posthumous Works"—collected and edited by Lesne.
- 1837. Froriep, "Kleinert's Repertorium."
- 1852. Lawrence, *Lancet*, p. 327.
- 1867. Marsh, *Lancet*, p. 298.
- 1880. Laacher, *Deutsche Archiv. f. klin. Med.*, Vol. XXVII, p. 268.
- Pyt. Quoted by Laacher.
- Meckel. Quoted by Laacher.
- 1882. Thoma, *Virchow's Archiv.*, Vol. LXXXVIII, p. 515.
- 1887. Kaufmann, *Deut. Med. Woch.*, No. 28.
- 1894. Tennant, *Edinburgh Medical Journal*, July, p. 29.
- 1898-99 Stockton, *Buffalo Medical Journal*, p. 97.
- 1898. Kronig, *Centralbl. f. innere Med.*, Vol. XIX, p. 178.
- 1900. Crispino, *Riforma Medica*, Nos. 187-189.
- 1901. Widenmann, *Berliner klin. Woch.*, No. 11.
- 1903. Glaser, *Deutsche Archiv. f. klin. Med.*, Vol. LXXVIII, p. 370.
- 1902. Doering, *Deutsche Archiv. f. klin. Med.*, Vol. LXXII, p. 407.
- 1905. Sailor, J. and Rhein, R. D., *American Journal Medical Sciences*, Vol. CXXIX, p. 688.
- 1906. Hildebrand and Hess, *Munchen Med. Wchnschr.*, LII, p. 745.
- 1908. Arnsperger, H., *Deutsche Archiv. f. klin. Med.*, XCIII, p. 88.
- 1911. Becker, T., *Fortschr. a. d. Geb. d. Röntgenstr.*, XVII, p. 183.
- 1911. Eppinger, *Allg. v. Specielle Path. des Zwerchfells.*
- 1912. Scheidemandel, *Munchen Med. Wchnschr.*, LIX, p. 2168.
- 1912. Giffen, *Ann. Surg. Philad.*, LV, p. 388.
- 1913. Baetze, *Deutsche Archiv. f. klin. Med.*, CX, p. 49.
- 1913. Vogel, *American Journal Medical Sciences*, CXLV, p. 206.
- 1913. Motzfeldt, *Deutsche Med. Wchnschr.*, XXXIX, p. 312.
- 1913. Reuss, *Deutsche Med. Wchnschr.*, XXXIX, p. 743.
- 1913. Haase, *Wien. klin. Wchnschr.*, XXVI, p. 193.
- 1913. Kayser, *Fortschr. a. d. Geb. d. Röntgenstr.*, XX, p. 240.
- 1914. Stein, *Surg. Gynecol. and. Obstet.*, Vol. XVIII, p. 547.
- 1920. Weigert, *Beitr. z. klin. Chirurgie*, Vol. CXIX, p. 100.
- 1921. Kofferath, *Monatsschr. f. Geburtshülfe v. Gynakol*, Vol. LV, p. 33.

DISCUSSION.

Sir HUMPHRY ROLLESTON, K.C.B., said that the Society had been fortunate in having a masterly paper by a radiologist who was an anatomist, and had thrown light upon the subject from the anatomical, pathological, and radiological point of view. He had correlated together three groups of cases. The first group consisted of the cases known as Petit's eventration, cases which used to be spoken of as congenital or false diaphragmatic hernia. The question remained in his (the President's) own mind as to whether these cases were not due to a congenital atrophy of the muscular fibre of the diaphragm, which might remain latent through life unless some stricture or twisting of the stomach took place. Dr. Morison had put forward a view which involved a definite cause for the atrophy of one-half of the diaphragm occurring very early in life, and it was certainly a remarkable fact that this congenital or false diaphragmatic hernia was so very much more common on the left than on the right. The second group of Dr. Morison's description included the cases in which there was a definite history of injury or wound giving rise to a traumatic hernia; and the third group consisted of cases in which there was a definite paralysis of the phrenic nerve on one side. The paper appealed to the anatomist, the X-ray specialist, and the practising physician. He understood that Sir Charlton Briscoe, who had paid great attention to this question, had brought some slides illustrating massive collapse of the lung, and he would call upon him to show them now.

Sir CHARLTON BRISCOE said that he had been concerned in the past more particularly with the effect of lesions of the diaphragm on structures above it, and as the paper had concerned itself practically with the effect on structures below, he did not think it would be in place for him to show the slides he had brought, which dealt with collapse of the lung. He had always been taught that these hernia cases really arose owing to the fact that the diaphragm originally developed in two parts—a costal portion and a crural portion, the crural portion being defined by Keith as that part which arose from the spine and the arcuate ligaments. Keith laid great stress on the fact that there was frequently a defect at that point, and this was actually the fact. If one dissected a number of diaphragms, one found quite commonly that opposite the tips of the twelfth rib there was a failure of the two lots of fibres to meet. There was quite commonly a triangle at this situation, the apex of which was at least one or two inches from the twelfth rib. Sometimes it extended right up to the lateral leaflet. As a matter of fact, it was equally common on the right and on the left, but he did not think there was much possibility of a hernia occurring on the right side, owing to the position of the liver. He rather gathered that the lecturer had not taken that fact into consideration at all.

Another interesting point, of which he had come across one example, was that the muscle fibres might be missing in the other parts of the diaphragm without any clinical signs. He had one *post-mortem* specimen in which there

were no muscle fibres whatever on the right side of the diaphragm, at the points of attachment to the costal margin from the middle line down to the eleventh rib. The fibres were represented simply by fibrous bands. He saw that patient during life, the man being under his care for septic endocarditis, and he had been particularly interested in investigating his respiratory movements, which in other respects were perfectly normal.

Passing on to paralysis of the phrenic nerve, he quite agreed that it was very common. He had records of four *post-mortem* examinations in which the diaphragm was definitely paralysed and the phrenic nerve destroyed. These were mostly cases in which there were new growths in the chest, and three of these were on the left side. This condition was frequently missed during life because fluid was present. It was generally missed also in the *post-mortem* room, because people did not take the trouble to dissect out the nerves, and the degenerated muscle showed very little difference from the normal muscle. The only thing noticeable might be that the affected muscle was a little browner than that of the normal side and lacked the purplish tinge, and also lacked the elasticity. He agreed also with what had been said by Dr. Morison, that there were no physical signs by which paralysis of one-half of the diaphragm could be detected. It might be suspected very strongly, but there were no true physical signs, no alteration in the size of the chest, no alteration in any of the accessory muscular actions, the intercostal, the scalenus, and so on, by which the paralysis of one-half of the diaphragm could be detected. Therefore the X-ray picture was of enormous value. There was one little sign in cases of paralysis of the left half of the diaphragm which might be worth remembering, namely, that just at the end of inspiration one saw a little tug of the mediastinum to the right. That seemed to be of great value in a case where one had clouding by fluid on the left side.

Continuing, Sir Charlton Briscoe said that he did not wonder that physicians should disagree, but he was always astonished when anatomists did. He was very much interested in the nerve supply of the diaphragm, and he did not at all agree with the statement that the intercostal nerves supplied the diaphragm, at all events in man; they went through it. There were no fibres, so far as he could see, running up into the diaphragm itself, and Dr. Barclay Smith, of King's College, had confirmed that point. In the case of the cat and rabbit, he thought these nerves might supply a small strip of the margin of the diaphragm, something like one-eighth, not more. If the phrenic nerve in the rabbit were cut it made no difference to the rabbit at all. When the animal was killed ten or twelve months afterwards there was the fringe left round, but nothing more. Lady Briscoe had done a certain number of experiments on animals in the direction of stimulating the intercostal nerve in order to watch the effect on the diaphragm. In a large number of cases no contraction of the diaphragm was obtained at all, but in one or two there was a contraction, and this contraction was obtained better on stimulating centrally than peripherally after the intercostal was cut.

There was one point on which he would like to ask for information, namely,

the question of temporary elevation. A certain number of cases were found in children, especially after bronchitis, in which there was a deflation of the left lower lobe. This condition was quite common. He had seen one child three times because it was thought she had pneumonia ; she had all the signs of deflation of the lower lobe, and each time she had recovered perfectly. It would be interesting to have any light thrown on that side of the question.

At a later stage in the meeting Sir Charlton Briscoe was prevailed upon to show his slides and give a brief explanation of them. The first showed the condition of the lung in one of the cases in which the diaphragm was very high. This was a case in which a man had a gumma of the spinal cord at the level of the eighth cervical segment, so that he was paralysed completely below that level. The interesting point was that in this case the diaphragm was working with no assistance from the abdominal or lower thoracic muscles. The lower lobes were completely deflated. It took about thirty-six hours for the lower lobe to become completely deflated. Another slide showed, in parallel fashion, the excursions of the diaphragm in the normal and in an individual who had a gunshot wound in the spinal cord. He pointed out that deflation of the lower lobe was consistent with a perfectly healthy diaphragm.

Sir ARCHIBALD REID expressed his admiration for Dr. Morison's paper. He himself was sitting at the feet of Gamaliel in this matter, for Dr. Morison's experience transcended his own, both in respect to number and variety of cases. Dr. Morison's remarkable cases would help them all to pay more attention to these matters than they had done in the past. He (the speaker) had in mind one case in which he was not quite certain as to the condition. It was a case of what he took to be congenital hernia, only discovered when the patient was forty years of age. It went right up from the middle of the diaphragm to the cardiac side—that is to say, it filled right up alongside the line of the spine. There was not a complete bow-line, but one apparently starting from the centre of the diaphragm and going inwards towards the mid-line, and that again filled completely when the patient was lying down. The patient had very acute symptoms for a short period, and since the discovery of the anomaly had not had them any more. He had been completely comfortable since the condition, which was probably congenital, was discovered. He wished to congratulate and to thank Dr. Morison.

Dr. ROBERT KNOX expressed his appreciation of Dr. Morison's paper, to which he had very little to add. Indeed, the paper had been so complete, especially from the radiological point of view, that there was little else to be said. But he would like to add one other to Dr. Morison's list of cases of right-sided unilateral elevation. He had a patient who had, to begin with, a left-sided pleural effusion, and then suddenly had marked dullness on the right side. On screen examination the diaphragm on the right side was observed to be at a high level ; later a little fluid was observed. Sir Charlton Briscoe, who saw the case, suggested right-sided elevation of the diaphragm due to pressure from a tumour upon the phrenic nerve and causing a

temporary paralysis. A tumour of the mediastinum was diagnosed and X-ray treatment given. Under this treatment the tumour cleared up, and as the pressure was relieved the diaphragm recovered its movements.

LADY BRISCOE, responding to the invitation of the President, recounted the experiments she had carried out on the cat and the rabbit with a view to differentiating the different parts of the diaphragm. Her technique in these experiments had been to open the chest, and to attach threads to the crus on one side and to the dome on the same side, and record the movements on a moving drum. She was able to show in this way that the two parts of the diaphragm, the crus and the dome, moved at different times and with different excursions. When the animal was lying flat on its back the two movements were fairly equal, but usually the crus came in just before the dome. It was quite a small change, but it was definite. If the animal's back were extended it would be found that the movements of the crus were increased, and the movements of the dome decreased, the change in time becoming much more apparent, so that the crus came in earlier than it did before. If the animal's back were flexed, the movement was reversed altogether, the dome being bigger than the crus, and coming in earlier. She was able to support this by another experiment. The same arrangement was made, and the phrenic nerve on the same side was stimulated with various shocks from a secondary coil. The drum was set revolving, and the shocks were sent in with the secondary coil at 15, 10, 5 cm., getting stronger each time. When the animal was lying on its back there would be responses with all three different strengths of shock, but when the spine was extended, the crus would still respond to the weak shock, but the dome would not respond at all. When the animal was flexed the reverse took place, the dome responding to the weak shock, and the crus not responding. She thought that this showed pretty well that with extension the crus was responding a great deal better than the dome. One other point to bear that out was, that with one side of the thorax open and spontaneous respiration going on she cut the anterior branch of the phrenic going to the one dome, and was able to show that the crus went on contracting while the dome went out altogether. She tried later on to find out how this worked. She could only come to the conclusion that it was a change of tension—that when the spine was extended there was more tension in the crus. She tried to investigate the action by means of the electrocardiograph, and took records with the spine in three different positions, but all she was able to show was that there was no change in the actual conduction of the muscle because the excitation wave arrived at the spot where the electrodes were placed at identically the same moment, or at any rate within one-thousandth of a second. It was not a change in conduction rate, and she thought that probably it was a change in the tension of the muscle.

Dr. R. W. A. SALMOND showed a slide of a case, that of a woman, aged 37, who came into hospital for varicose veins, with no chest symptoms at all, and it was only on the house surgeon examining her previous to operation that he

found her heart was displaced. The radiograph showed the bow-line very clearly, and the elevation of the diaphragm. He thought at the time that it was a case of unilateral left-sided phrenic paralysis. On filling up the stomach with a bismuth meal, the lower end of the stomach was practically on a level with the right side of the diaphragm, and the stomach filled from below right up to the very top. He did not think, if this was a case of Petit's eventration, that there was any "cup and spill" stomach in this case. The diaphragmatic movements were nil. The patient showed neither inverse movements nor the ordinary normal movements. Did Dr. Morison think this a case of Petit's eventration or one of left-sided unilateral paralysis? The condition caused no symptoms.

Dr. WOODBURN MORISON, in replying on the discussion, said that his subject was a large one, and, of course, he had had to leave out a great deal—for instance, the question of those congenital defects in the diaphragm, so well described by Sir Arthur Keith in the *British Medical Journal* in 1910. He omitted this and other matters simply on account of the limits of time; his references to literature also had been scanty for the same reason. He was afraid that anatomists did differ very considerably. He found that text-books were very much alike, but anatomists themselves differed on various points. The point he was trying to make was that the intercostal nerves could be traced into the diaphragm, and there was some stimulation from the intercostal in the case of the lower animals. He was well aware that arguments from the lower animals were likely to be fallacious; but at the same time he had difficulty in explaining why it was that there was such a very long time after the phrenic nerve was apparently destroyed before one got a corresponding atrophy of the diaphragm muscle, and it seemed reasonable to look to comparative anatomy for an explanation. He was greatly interested in Lady Briscoe's remarks, particularly with reference to the crura of the diaphragm. He himself had done some work on this in connection with cardiospasm, and he would like to draw her attention to that interesting condition on which the surgeon at present could do nothing. If these cases were operated on nothing whatever was found. He had seen the stomach opened in such cases, and still no visible abnormality. He thought it might be due to some extraordinary action of the crura, that there might be some peculiarity or some spasm there. The condition was one of which they saw a great deal in Manchester, and the cases went on practically from year to year without anything being done to them. Sir Archibald Reid had mentioned a curious case of his own. There was a similar case reported by Tennant in the *Edinburgh Medical Journal*, of July 29th, 1894; there it was described as a diaphragmatic pouch, the only case of that kind on record. An absence of muscular fibre was found in that portion of the diaphragm only; it was not a true hernia because it had a sac. With regard to Dr. Salmond's case, he thought it possibly a case of Petit's eventration, though further details might make that view untenable.

A vote of thanks was accorded to Dr. Woodburn Morison on the motion of the President.

THE STIMULATING AND PARALYSING EFFECT OF X RAYS.

By W. E. SCHALL, B.Sc., F.Inst.P.

In the German X-ray literature a lively controversy is going on as to whether X rays have a stimulating effect, and if so, whether this can be used for therapeutic purposes.

In Volume XIV of *Strahlentherapie* there are numerous articles on this subject.

Dr. V. Hoffman, on pages 615-626, describes experiments made on twelve kittens and thirty-six young rabbits. He argues that the effect of X rays on bones can be observed more accurately than that on other tissues, and that it can also be better localised, so that the influence on the whole body remains as small as possible. He therefore irradiated one tibia of each animal, and found that upon exposure to 10 to 20 per cent. of the erythema dose growth was more rapid in the majority of cases. The increase never amounted to more than 8 to 10 per cent. compared with the corresponding unexposed tibia of the same animal, which increased in length 2 cm. during four weeks. Microscopic examinations of sections of the exposed and unexposed tibiae also showed well marked differences.

When the dose was only 5 per cent. of the erythema dose no stimulating effect could be noticed, and when it was 25 per cent. a paralysing effect was already noticeable. Moreover, the stimulating effect could not be produced on all animals, even if they were of the same litter. When occasional applications were given, over a period of from six to eight weeks, with a total dose not exceeding 30 to 35 per cent. of the erythema dose, stimulation could be produced with more certainty than when 15 per cent. were given in one sitting.

The stimulating effect is only temporary, and after some months the unexposed tibiae had reached the same length as the exposed ones. In concluding, the author says that there are great difficulties to be surmounted before the stimulating effect can be used therapeutically.

The paralysing effect can be produced with a much greater degree of certainty. It begins with some 25 per cent. of the erythema dose; and with 40 per cent., all, even older, animals are affected, as long as they are still in the growing stage. To produce a lethal dose for cells of the bones, more than 300 per cent. of the erythema dose has to be given.

On pages 538-557 experiments on the action of X rays on the growth of plants are described.

Jüngling and others exposed beans, seeds of *Vicia faba*, which they found to be specially susceptible to X rays. Those seeds which were exposed to stronger doses while yet dry began to strike roots earlier, and the young plants grew more quickly than those which were exposed to weak doses, or were not exposed at all; but the quicker rate of growth was not maintained for a long time. With seeds which had been kept in water for three days, and in which the roots just became visible, weak doses still had a slightly stimulating effect,

but stronger doses already retarded the growth. Very young plants exposed to X rays were injured even by weak doses. Similar results were found independently by others.

Sierp and Robbers describe experiments with very young plants of oats (*Avena sativa*), which do not react nearly as much to X rays as beans do. The plants were carefully protected from ordinary light, even from the light emitted by the X-ray tubes, and the rate of growth was measured with a horizontal microscope with dull red light. Readings were taken every ten minutes. Even short exposures to X rays stimulated the rate of growth for a short time, but already, after a few days, control plants began to grow more quickly and reached a greater height than any plants which had been exposed for even five seconds only. The X rays therefore had solely a paralysing effect.

In the *Fortschritte auf dem Gebiet der Röntgenstrahlen*, 1922, pages 687-689, Drs. Schwarz and Czepa of Vienna, criticise the numerous previous publications, which seem to prove a stimulating effect, though of short duration. They declare that these experiments were made with much too small a number of plants, and that errors are sure to arise, because there is invariably a great difference in the rate of growth of very young plants. The experiments would be conclusive only when carried out with many hundreds of seeds and young plants. They exposed many thousand specimens of the seeds of various plants, and invariably noticing a paralysing effect, conclude it to be a myth that X rays may have a stimulating effect on plant growth.

NOTES AND ABSTRACTS.

Fractures of the Femur in Children.—C. G. BURDICK and T. E. SIRIS (*Annals of Surgery*, June, 1923, p. 736).—This is a report on the treatment and end results in 268 cases, and it comprises cases of fracture of the femur in children up to the age of thirteen years.

1. Fractures of the femur in children are almost invariably followed by a good functional result. A satisfactory anatomical reduction is not essential for perfect function.
2. Children up to the age of six years are best treated in a Bryant frame. Over six, plaster spica with traction.
3. Suspension treatment in a Hodgen or Thomas splint is not practicable except in compound fractures, simple fractures with laceration, or severe trauma to adjacent tissues, where the administration of an anæsthetic

is contraindicated and when skeletal traction is to be employed.

4. An open reduction is rarely indicated, as skeletal traction will almost invariably correct any marked deformity. C. P. G. W.

A Case of Jejunal Diverticula.—L. R. BRAITHWAITE (*Brit Jour. Surg.*, July, 1923, p. 184).—Braithwaite describes an interesting case of a man, aged 54, who was thought to be suffering from old tuberculous peritonitis or atonic dyspepsia. X-ray examination, however, clearly revealed the fact that the pathological condition was one of multiple diverticula of the jejunum. Laparotomy was performed and the diagnosis confirmed; the upper third of the small intestine showed numerous diverticula along its mesenteric border, but bulging free into the peritoneal cavity. The largest was larger than a Tan-

gerine orange, whilst the smallest was about the size of a pea. The first diverticulum was at the duodeno-jejunal flexure, and it was owing to its high position in the small intestine that excision was thought to be inadvisable. A lateral anastomosis was made between the anti-mesenteric border of the upper end of the jejunum and the intestine below the diverticula. The patient made an excellent recovery. Four months later the patient was operated upon a second time. The uppermost diverticulum, which lay at the duodeno-jejunal flexure, was infolded. The portion of intestine infected by disease, amounting to about four feet, was then excised immediately below the existing anastomosis, and the divided ends were closed. The patient made an excellent recovery.

C. P. G. W.

The Spiral Secondary Diaphragm.—AKE AKERLUND, Stockholm (*Acta Radiologica*, Vol.

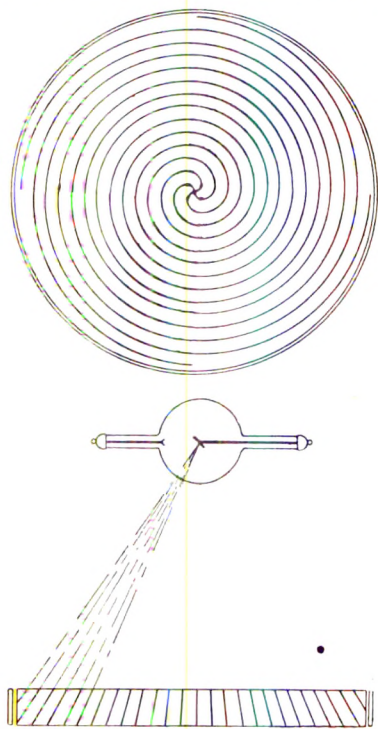


FIG. 1.

The diaphragm has the form of a rotating, flat circular disc, made of a material easily permeable to roentgen radiation, e.g., bakelit. Into this disc some spiral lead bands are let in, placed parallel to each other and close together and carefully centred in the centre of motion, being at the same time adjusted in the direction of the primary rays, i.e., converging towards the focus of the tube.

II, Fasc. 1, pp. 77-82.)—A report—with reproduction of some original roentgenograms—on the construction and appearance of the spiral secondary diaphragm described in the last number of this journal, as well as on its

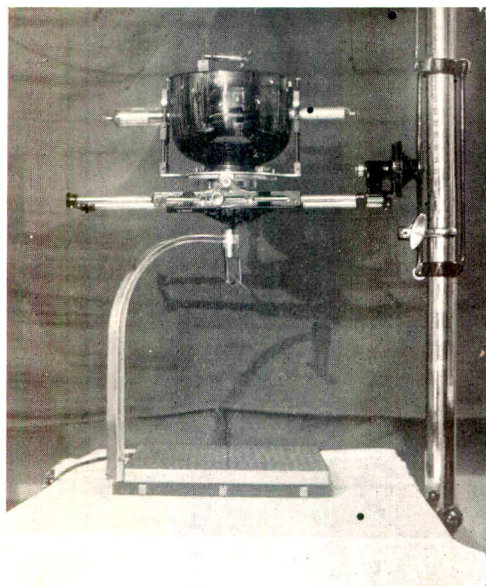


FIG. 2.

The diaphragm with the centring device placed on a plate holder.

practical use and effectiveness compared with that of the secondary diaphragm of the Potter type.

Metastatic Tumours of Bone.—C. A. JOLL (*Brit. Jour. Surg.*, July, 1923, p. 38).—In this excellent Hunterian Lecture, delivered before the Royal College of Surgeons in 1923, Joll states that secondary tumours in bone must arise in one of three ways:—

1. By direct extension of a tumour from tissues outside the bone into its substance.
2. By extension through the blood stream, either by malignant emboli conveyed through nutrient arteries, or possibly by a retrograde route through the veins.

3. By extension through lymphatic paths.

Evidence was brought forward in favour of the claim that bone metastases are blood borne, and that they are due to the lodgment of malignant emboli in the cellular marrow.

The records of the autopsies at the Cancer Hospital from 1888 to 1922 were examined, and it was found that fifty-three metastases in bone were found in 1,144 autopsies for malignant disease. Out of the fifty-three cases thirty-four were secondary to malignant disease of the breast. The location of the bone metastases in the fifty-three cases was interesting; the following is a table:—

Bone.	Number.	Percentage.
Vertebrae ...	19	21.6
Ribs ...	18	20.4
Sternum ...	13	14.7
Femur ...	13	14.7
Skull ...	9	10.2
Humerus ...	7	7.9
Pelvis ...	4	4.5
Tibia ...	2	2.2
Mandible ...	1	1.1
Scapula ...	1	1.1
Clavicle ...	1	1.1

Spontaneous fractures occur in both primary and secondary tumours of bone, but in the former the tumour has generally been noticed before the fracture, while with the latter fracture may be the first thing and the tumour is then detected. Union of such fractures is much more likely to follow when the growth is a secondary deposit than when the fracture is associated with a primary sarcoma, this difference being possibly related to the osteoplastic properties of some secondary growths.

X-ray investigation should help materially in the diagnosis of these growths. Joll quotes Bloodgood, who holds that the distinction from a primary tumour can be made, as a rule, because in the skiagram there is evidence both of bone destruction and of bone formation in the central shadow, while, except in a healing bone cyst, this is never found in primary growths.

C. P. G. W.

Parenchymatous Hypertrophy of the Breast.—D. C. L. FITZWILLIAMS (*Lancet*, Vol. II, 1923, p. 218).—A case of parenchymatous hypertrophy of the breast is described. It occurred in a married woman, aged 27. Both breasts were affected, and the enlargement had increased greatly. This may have been due to pregnancy, for the patient was two months pregnant. On examination, both breasts were

very large; the veins were enormously distended, while the nipples were quite flattened and flush with the skin. X-ray treatment was given but had very little effect, and the increase in size went on. At the fifth month of her pregnancy the patient aborted, and the breast rapidly diminished in size.

The cause of this disease is unknown. Trauma, cold, heat and irritation have no effect. The enlargement of the breasts begins first at or about puberty, and secondly, during pregnancy. It must therefore have something to do with the other sexual secretions, but what this association is we do not know.

C. P. G. W.

A Depressed Fracture over the Angular Gyrus: Clinical and Radiological Localisation.—A. P. BERTWISTLE (*Brit. Jour. Surg.*, July, 1923, p. 73).—The clinical case recorded was that of a right-handed quarryman, who sustained a compound fracture in the region of the left angular gyrus and subsequently developed a mild aphasia. Bertwistle has devised a method rendering it possible to visualise, in radiographs, the relationship of the underlying gyri and sulci to the skull as a whole and to the parietal bone. The method was as follows: The half of a sagittally divided skull, with a corresponding half of a brain were taken. Between the more important gyri were implanted pieces of copper wire moulded according to the shape of the sulci. The boundaries of the parietal bone—where not obvious—were marked by glueing a thin copper wire on to its margin. The brain was placed in the skull and radiographed lying on its mesial surface, so that the picture is a true lateral one. This key radiograph is useful in reading skiagrams of skulls. A base line is drawn from nasion toinion on both skiagrams, and by means of lengths along this line and perpendiculars to it localisation is possible.

This method promises to be most useful.

C. P. G. W.

Loose Bodies in Joints and Bursæ due to Synovial Osteochondromatosis.—M. S. HENDERSON and H. T. JONES (*Journal of Bone and Joint Surgery*, July, 1923, p. 400).—These authors review the literature of this condition and describe eighteen cases in detail. They are of the opinion that osteochondromatosis

of the synovial membrane is one of the causes of osteocartilaginous loose bodies in the joints, and probably the sole cause of the bodies in bursæ and tendon sheaths.

The authors regard the condition as a benign neoplasm, and consider that trauma is a secondary factor.

One case in the series recorded was as-

sociated with a chondro-sarcoma of the lower end of the femur.

As regards the treatment of this condition, the joint should be opened and all the loose bodies removed; this will give relief in the majority of cases. Amputation or resection is not called for in synovial osteochondromatosis.

C. P. G. W.

PUBLICATIONS RECEIVED.

Book.

Sinic Bulletin. 298.

Journals.

British Journal of Dermatology and Syphilis, August-September, 1923.

Journal of Bone and Joint Surgery, July, 1923.

Journal of Laryngology and Otology, September, 1923.

Journal de Médecine de Bordeaux, August 25th, 1923.

Journal de Médecine de Lyon, August 20th, 1923.

Journal of Radiology, August, 1923.

Kongresszentralblatt für die Gesamte Innere Medizin und ihre Grenzgebiete, August 13th, 20th, 27th, 1923.

Journals—continued.

Medical Journal of Australia, July 14th, 21st, 1923.

Medical Science, Abstracts and Reviews, September, 1923.

New York Medical Journal and Medical Record, August 15th, 1923.

New York State Journal of Medicine, August, 1923.

Norsk Magazin for Lægevidenskaben, July, August, 1923.

Il Policlinico, August 15th, 1923.

La Radiologia Medica, August, 1923.

Strahlentherapie, Band XV, Heft 5, 1923.

Urologic and Cutaneous Review, August, 1923.

NOTICES.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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A list of collaborators at home and abroad is being prepared. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

THE TREATMENT OF ACTINOMYCOSIS BY X RAYS, WITH A REPORT OF NINE CASES.

By CECIL P. G. WAKLEY, F.R.C.S. Eng., Consulting Surgeon to Maudsley Hospital; Assistant Surgeon and Teacher of Clinical Surgery, King's College Hospital.

It has often been stated that actinomycosis is a rare disease in this country, but this is certainly not the case in the London district. During the last three years eleven cases have presented themselves for treatment at King's College Hospital; of these, nine were treated by X rays combined with other methods. Two cases were very advanced when they came under observation, and were too ill to receive treatment. Even to-day, although the clinical signs are fairly evident, there is often much delay in diagnosis and valuable time wasted as far as treatment is concerned. The thoracic variety is often diagnosed as phthisis, and patients are treated as such; meanwhile the disease progresses, and often a correct diagnosis is reached only when the chest wall has been penetrated, sinuses have formed, and actinomycotic granules found in the exuding pus. By the time granules are detected in the sputum the case is far advanced, and the possibility of cure is very remote.

In the cutaneous variety delay in diagnosis is frequently caused by failure to identify the organism, which may only be discovered after repeated examinations.

In cases of actinomycosis of the appendix the diagnosis is only made either by microscopical examination of the affected part after removal, or of the pus exuded from the broken down wound, when this has occurred.

Infection by actinomycosis commonly occurs through the mouth, the lower jaw being invaded generally through a septic tooth; the tongue and fauces may become infected through an abrasion, while the face and neck may become involved by infection through the salivary ducts. The lungs are infected by inhalation of the streptothrix in dust. The commonest site of the disease in the alimentary tract is the caecum and appendix.

With regard to treatment, this should always be combined; it is hopeless to

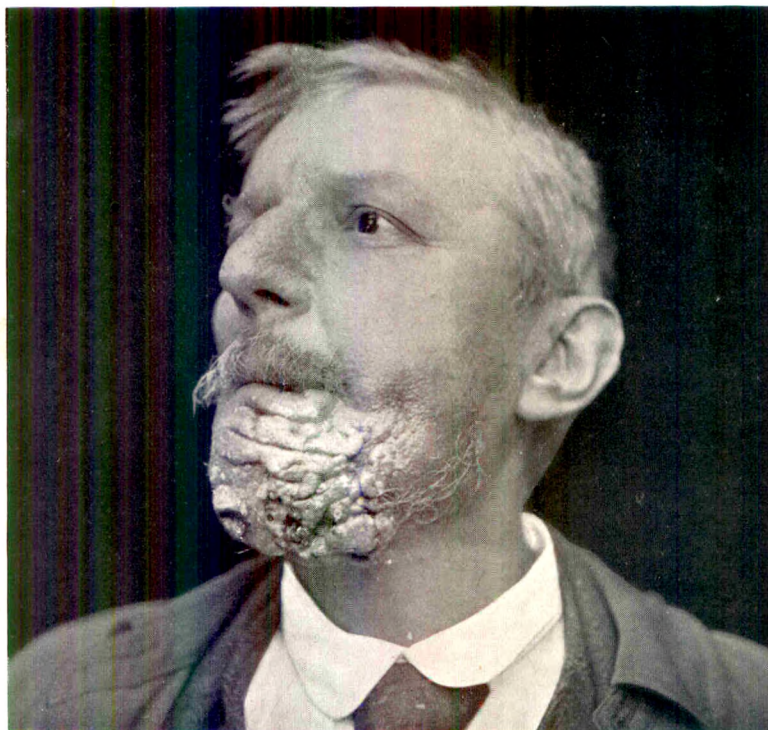


FIG. 1.—Case 2. Showing condition one month before death.

endeavour to treat such a disease by one single method. Excision or scraping of the sinuses, with injection of 2 per cent. iodine in rectified spirit, should be carried out where possible, while large doses of potassium iodide should be given internally. X-rays form a very important part in the treatment; the induration around sinuses disappears and scar tissue is often softened remarkably. Frequently, however, this form of treatment is not adopted until the disease is very far advanced and all other methods have been tried. X-ray treatment should be started early and will then be found a very useful adjunct. Radium has not been used frequently in this country in the treatment of actinomycosis, although Heyerdahl of Christiania reported six cases in 1919; four of these were clinically cured, while the other two were improved.

Several cases of actinomycosis due to the organism being rubbed in through the intact skin were reported during the war. In the majority of cases this was due to the soldiers sleeping on straw, while Pringle reports a case of actinomycosis of the anus in a huntsman who made use of straw after defæcation; the pustular eruption which ensued spread into the rectum.

ACTINOMYCOSIS OF LUNG.

CASE 1.—Harold T., æt. 25 years, was admitted to hospital 7th January, 1920, with multiple abscesses over both shoulders. These were opened and were found to contain numerous colonies of actinomycosis. The abscesses were irrigated and packed with gauze wrung out in 2 per cent. iodine in rectified spirit. For two years previous to admission the patient had been treated for

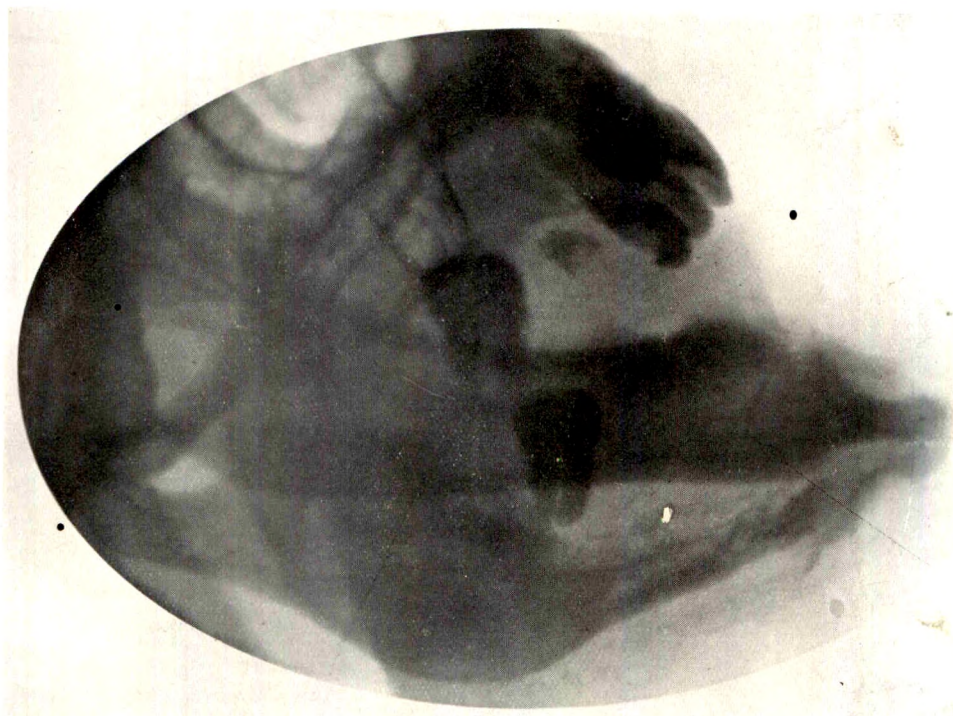


FIG. 2.—Case 2. Skiagram showing considerable cario-necrosis.

pulmonary tuberculosis, but no tubercle bacilli had ever been found in his sputum. Potassium iodide up to 800 grains a day was given by mouth, and as soon as the abscesses healed X-ray treatment was given to the thorax. After a few weeks, however, fresh abscesses appeared and broke down, and in spite of all treatment the patient died on the 16th May, 1920. Amount of X-ray treatment given, forty two pastille doses.

ACTINOMYCOSIS OF JAW.

CASE 2.—John M., æt. 57 years, came under observation in October, 1920, complaining of a small abscess under the chin. His previous history was as follows:—

In July, 1920, he had three teeth removed from his lower jaw, on account of an abscess at the root of one of them. Soon after this his gums began to ulcerate, and the ulceration spread round the lower jaw. In September, 1920, all the teeth were removed from the lower jaw except the last molar on each side. When first seen in October, 1920, the abscess under the chin was incised and the pus examined; it was found to contain numerous actinomycotic colonies. Large doses of potassium iodide were given by mouth and the abscess cavity was freely curetted and

packed with 2 per cent. iodine solution. X-ray treatment was commenced in January, 1921, radium 60 mgr. 2 mm. filter was inserted for twelve hours into the chin on four occasions. At first the induration around the abscess cavity disappeared, but in June, 1921, it rapidly spread. Several abscesses formed and discharged large quantities of pus; actinomycotic colonies were still present. In July, 1921, the induration had spread to the whole lower lip (Fig. 1).

A skiagram of the lower jaw was taken about the same time (Fig. 2). It demonstrated considerable cario-necrosis of the mandible. The indurated tissue was again curetted in August, 1921, and some of the material removed was examined microscopically, and it was found to be

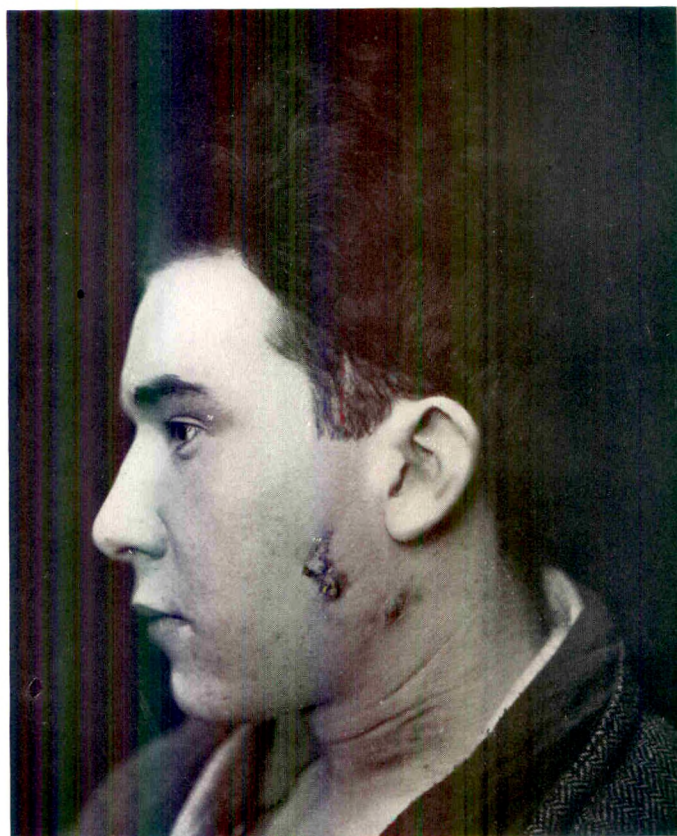


FIG. 3.—Case 3. Condition before X-ray treatment was started.

epitheliomatous. A few days after the operation in August, erysipelas appeared on the face and quickly proved fatal.

CASE 3.—Thomas M., æt. 19 years, was admitted to hospital 5th March, 1921, with a small sinus over the left side of the lower jaw. The patient had noticed this for five months, and stated that it appeared after a dead tooth had been removed. The sinus was scraped and plugged with gauze. On examining the tissue removed, small colonies of actinomycosis were discovered. The sinus was irrigated daily with 2 per cent. iodine in rectified spirit, while large doses of potassium iodide were given internally. As soon as the sinus was healing from the bottom, X-ray treatment was commenced, one pastille dose being given every six days. The sinus was completely healed by the end of March, 1921, but the X-ray treatment was continued until the end of May, 1921. When seen after twelve months there was no sign of recurrence.

CASE 4.—John P. A., æt. 45 years, came under observation in January, 1921, with a sinus from the left side of the lower jaw. Actinomycotic colonies were obtained from the discharge from

the sinus. The sinus was excised and the wound packed with 2 per cent. iodine solution. It healed slowly from the bottom. X-ray treatment was started from the first and was continued for three months. The wound healed well, and the induration which was present at first completely disappeared. When the patient left hospital he was put on large doses of potassium iodide for three months. A year later there was no sign of any lesion of the jaw. Amount of X-ray treatment given, 30 pastille doses.

CASE 5.—Agnes B, æt. 25 years, came under observation early in 1923, complaining of an abscess under her chin. Six weeks previously the patient noticed a small boil on her chin. Fomentations were applied and the boil disappeared, but the anterior part of the lower jaw commenced to swell. On admission to hospital there was considerable thickening of the right side of the lower jaw and chin, with a swelling of the upper part of the neck. There was marked

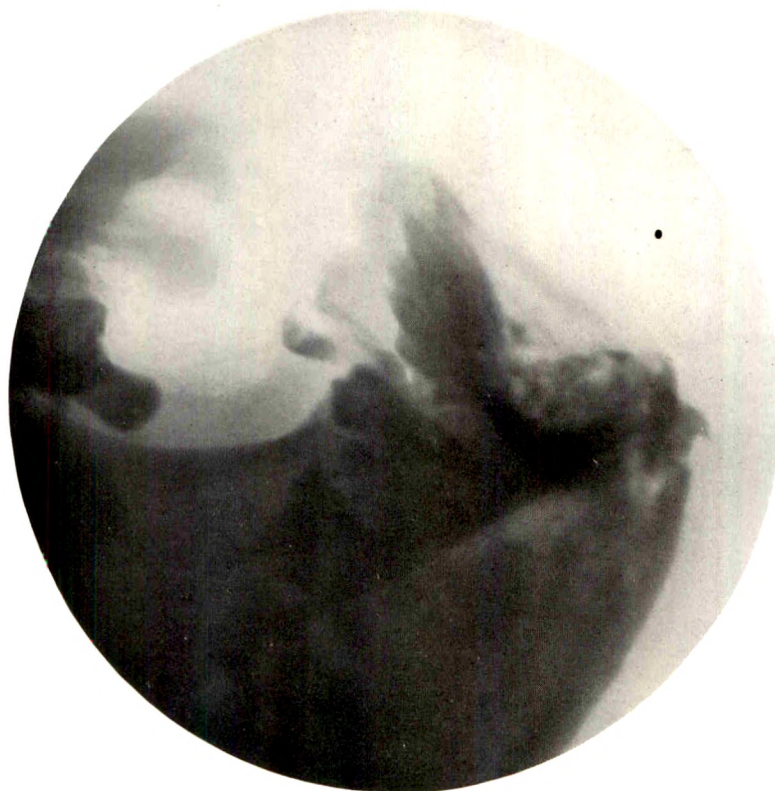


FIG. 4.—Case 5. Showing extensive cario-necrosis of anterior part of mandible,

induration of the floor of the mouth and an ulcerated discharging surface over the chin. The incisor and canine teeth were quite loose. Skiagrams of the lower jaw were taken, which showed a definite cario-necrosis of the anterior aspect and alveolar margin of the lower jaw. There was extensive caries, numerous sequestra, and marked rarefaction around the roots of the teeth in the affected area. (See Figs. 4, 5 and 6). Under an anæsthetic the teeth from the lower jaw were removed and the floor of the mouth was scraped down to the mandible. The cavity was plugged with gauze soaked in iodine. Large doses of potassium iodide were given internally. As soon as the inflammation was subsiding X-ray treatment was commenced, two treatments being given each week. The wounds healed up and all the induration had disappeared after six weeks. The X-ray treatment was continued for another six weeks. When seen after five months there was very little evidence of any former infection. There was no sign of induration, the skin was normal, and the patient was fitted with a partial lower denture.

ACTINOMYCOSIS OF RIGHT SIDE OF NECK.

CASE 6.—F. Thomas H., aet. 19 years, came under observation in June, 1921, with a hard indurated abscess on the right side of neck. This was opened, and the pus on examination was found to contain colonies of actinomycosis. The abscess cavity was freely curetted and washed out with a 2 per cent. solution of iodine. Potassium iodide was given by mouth in large doses, up to 700 grains a day. X-ray treatment was started in July, 1921; the whole side of the neck was irradiated each week. In September the patient developed an abscess over the upper part of the right side of his chest. This was of the same nature and was curetted and packed with iodine solution. X-ray treatment was given to the whole thorax. Actinomycotic colonies were found in the sputum. The patient gradually went down hill; in January, 1922, the

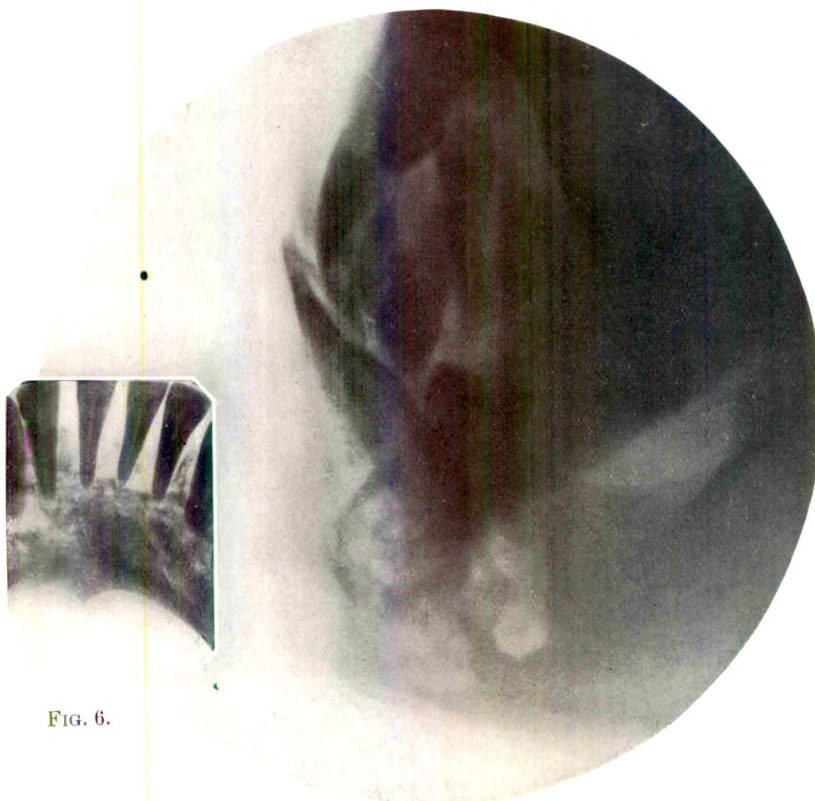


FIG. 6.

FIG. 5.

FIG. 5.—Case 5. To show necrosis of the mandible. The chin has disappeared.

FIG. 6.—Same case. To show necrosis around dental sockets.

right lung was solid and there were several sinuses on the right side of the chest. The blood count was as follows:—

Red blood corpuscles	...	3,996,000 per cubic millimetre.
		{ 79.9 per cent. of normal.
Hæmoglobin	...	50 per cent. of normal; colour index, .6.
Leucocytes	...	28,200 per cubic millimetre.

The patient died in February, 1922. Amount of X-ray treatment given, 38 pastille doses.

ACTINOMYCOSIS OF CÆCUM AND APPENDIX.

CASE 7.—E. L., female, aet. 26 years, was admitted to King's College Hospital, 22nd June, 1921, with symptoms of acute appendicitis. She gave a history of intermittent attacks of pain in the right iliac fossa for six months previous to admission. Appendicectomy and drainage was

performed on the day of admission. The appendix was retro-caecal in position, it was much enlarged and thickened, the lower part of the caecum was indurated and hard. The drainage tube was removed after three days and the wound had healed completely in three weeks, when patient was sent to a convalescent home. On microscopical examination of the appendix it was found to be invaded with actinomycosis. The patient was given increasing doses of potassium iodide, until she received 600 grains per diem. Six weeks after discharge from hospital the wound broke down and discharged pus containing colonies of actinomycosis; the sinus was opened and irrigated daily with 2 per cent. iodine in spirit. The sinus gradually healed up after three weeks of this treatment. X-ray treatment was now given to the right iliac fossa, using a 6 mm. filter. The region was divided into four squares, and each of these received one pastille dose each week. This treatment was given for two months. The wound remained soundly healed, and when the patient was seen eighteen months after her operation, no thickening could be felt in the right iliac fossa and she was in the best of health.

ACTINOMYCOSIS OF APPENDIX.

CASE 8.—E. H., female, æt. 36 years, came under observation in May, 1922, with a history of pain and tenderness in the right iliac fossa for the last four days. Appendicectomy was performed at once. The caecum was indurated and hard and the appendix about five times its normal size. The condition was thought to be due to actinomycosis, and a drainage tube was inserted down to the caecum. Sections of the appendix were examined microscopically and colonies of actinomycosis were discovered. The wound healed slowly. X-ray treatment was given to the right iliac fossa over a period of three months. There was no evidence of involvement by the streptothrix elsewhere in the body. The patient was seen nine months afterwards and seemed completely cured. Amount of X-ray treatment given, thirty pastille doses.

ACTINOMYCOSIS OF LUNG.

CASE 9.—Reginald B., æt. 25 years, came under observation in March, 1922, with an abscess just outside the erector spinal muscles opposite the eighth dorsal vertebra. This was considered to be a cold abscess, probably tuberculous in nature. On aspiration of the abscess and on examination of the pus, colonies of actinomycosis were discovered. The abscess was therefore freely opened and washed out with iodine solution and packed with gauze. Large doses of potassium iodide were given by mouth, while X-ray treatment was given to the lower aspect of the right thorax, back and front. In spite of treatment, however, numerous abscesses appeared over the right side of the chest, and the patient died in June, 1922. Amount of X-ray treatment given, twenty-five pastille doses.

The two cases of actinomycosis of the lung both proved fatal. This is not to be wondered at, because the disease was very far advanced by the time the patients came under treatment.

The two cases of appendicular actinomycosis both did well and were cured; in these cases there can be no doubt that X-ray therapy was most beneficial.

In Case No. 2, the question might be raised as to whether the X-ray treatment was responsible for the development of squamous cell carcinoma on the top of the actinomycotic lesion. Against this may be set the fact that no visible "reaction" was at any time observed to result from the irradiation.

REFERENCES.

- Brickner, W. M., "Extensive Actinomycosis in a Soldier. Recovery," *Med. Rec.*, 1920, 97, 167.
Cope, V. Z., "A Clinical Study of Actinomycosis," *Brit. Jour. Surg.*, Vol. III, p. 55.
Heyerdahl, S. A., "Actinomycosis Treated with Radium," *J. Am. M. Ass.*, 1919, 73, 1928.
Pringle, J. J., "Case of Actinomycosis," *Proc. Roy. Soc. Med.*, Lond. Dermat. Sect., 1919, 12, 12.
Spencer, W. G., "Actinomycosis," *Medical Science*, Vol. III, p. 239.

THE CAUTERIZATION OF ADHESIONS IN ARTIFICIAL PNEUMOTHORAX TREATMENT OF PULMONARY TUBERCULOSIS UNDER THORASCOPIC CONTROL.

By H. C. JACOBÆUS, M.D.*

(From the Medical Service II of the Serafimerlasarett, Stockholm, Sweden, Professor H. C. Jacobæus, Director.)

(Reprinted, with permission, from the *Proceedings of the Royal Society of Medicine*.)

(Continued from page 105.)

In perhaps the majority of cases one can see the compressed lung in its proper colour, greyish-blue with coal pigment, while the adhesion is greyish-red with distinct vessels in its longitudinal direction. The tissue is loose and spongy when pressed with the galvanocautery. Often the adhesion runs like a membrane along the ribs. It vibrates when the patient coughs or is shaken. In these cases there is also a transparent bluish colour. Without doubt, there exists an organic, membrane-like granulation tissue, which has become stretched and forms the essential adhesion. These adhesions are the most favourable for cauterization, which may be done easily, rapidly, and without pain worth mentioning. The danger of hæmorrhage surely cannot be great. I have burnt off adhesions with rather large, even varicose vessels without any bleeding whatever. With some experience it is not difficult to see the difference between the lung and the adhesion.

In other cases one sees the greyish-blue lung, with its coal pigment, stretching right out to the pleura, possibly with a small membrane, resembling a pleural membrane, in the fold between the lung and the chest wall. In these cases the thing to do is to loosen the pleura around the point where the adhesion is attached. If it is attempted to continue the cauterization, the distance between the lung and the chest wall gets smaller and smaller, and it becomes really impossible to continue without penetrating the lung. In such cases I have loosened the tissue around the adhesion as much as possible and then continued with pneumothorax treatment under high pressure. After an interval of time I have also performed a new cauterization in the same way. In one case I succeeded the second time in burning off an attachment which proved impossible at the first attempt. I think that it is in this way that one can, may be in a limited number of cases, enlarge the scope of the method. I performed the operation in two or more stages in only four of my first forty cases, using a moderate over-pressure between the two stages. The essential reason for this procedure is that it enables me with more certainty than before to avoid burning the lung. I think this point is very important. In such cases, where the lung is directly attached without this intervening tissue, I do not think it advisable to force any cauterization.

* At a Joint Meeting of the Section of Electro-Therapeutics with the Roentgen Society, at Manchester, November 17th; also delivered as an Occasional Lecture at the Royal Society of Medicine, November 22nd, 1922.

It is these latter cases, in which the adhesions are in greater part formed by lung tissue, which most often complicate the cauterization. In such cases one has to expect partly, as already mentioned, the existence of larger vessels, and partly tubercular changes and offshoots of cavities. The distinction between this type of adhesion and the preceding is not always distinct; there are transitional forms with both granulation and lung tissue, as proved by histological investigations which I have made. The cord-like, tense adhesions, thinner than a pencil, may well contain lung tissue and perhaps also offshoots from cavities, but they are still, in my opinion, not dangerous to cauterize; just as in the case of hæmorrhages, one has to attach a certain importance to the immediate, marked shrinkage of the adhesion after cauterization in preventing tuberculous infection of the pleura. While working with thoracoscopy, one can see the stumps of the adhesions shrink to half of their original size or less within a few minutes. Without doubt, where offshoots from cavities exist they must be compressed and obliterated. This sounds bold and hypothetical, but I believe that it is so. If these adhesions are microscopically examined, one finds not infrequently offshoots from cavities filled with necrotic tissue. To date, several hundred adhesions have been burnt off, and in only one known case (Holmboe) has a cavity been opened, with resulting mixed infection in the pleura. In this case there was a surface adhesion of considerable thickness, and the operation had been going on for nearly two hours without complete success in burning off the adhesion. The patient was so well on the second day after the operation that a new thoracoscopy was performed, but then quite unexpectedly there occurred a sudden perforation of the lung with mixed infection and acute empyema, which in a few days proved fatal. The autopsy did not entirely reveal the precise method of the pleural infection, nor how extensive the cauterization had been. In making this statement it is not my intention to deny that the result of the operation was unhappy. The incomplete cauterisation in the case in question was perhaps of importance, because the shrinkage which occurred could not have resulted to the same degree from any other cause. The tedious and severe pleurisies after the operation seemed to be caused by the opening of tuberculous foci by the cauterization, and then the infection spreads to the pleural cavity.

I have not infrequently had cord-like adhesions, which at X-ray examination and on thoracoscopy have been technically easy and possible to burn off, but in which I have nevertheless not done this, because it was necessary to consider the clinical effect obtainable by the removal of the adhesions in question. According to Saugman's and Gravesen's statistics, the difference between the prognosis of those cases with and those without adhesions is so great that practically all cord-like adhesions, which are technically possible of removal, provide an indication for cauterization. I believe that as long as one cannot, as is now the case, decide upon the risks of the operation, one ought to have some more definite indications. If, for instance, the case is one of a patient whose general condition is excellent, who has no sputum and whose

compressed lungs show no sign of cavity, I have not considered the indications sufficient for operation.

The unlimited possibilities of variation are, however, such that this rule cannot be absolute. If a patient has a cavity in the lung, and is without tubercle bacilli or sputum, and the lung is expanded by adhesions and is technically operable, then I consider it one for cauterization. In such a case, sputum or bacilli usually appear again sooner or later.

In some cases, as Holmboe and myself have pointed out, there is no sputum, but after every introduction of gas the patient suffers an intense, irritating cough for several days, which troubles him a great deal and prevents sleep. In these the adhesions are as a rule very narrow, and sometimes they do not even show on the X-ray photograph. I have not seen such symptoms in cases with extensive adhesions. I consider cases with such symptoms as full indications for cauterization, so much the more as these adhesions for the most part are very easy to remove.

Finally, the presence of an exudate influences the indications for operation. According to my experience, which, however, is not very great, an existing pleurisy always becomes worse after a cauterization. I have in two cases seen a serious empyema set in as a nearly direct consequence of this. With a pleuritic exudate present, it is also, as already mentioned, difficult to determine the operative possibilities. The pleural surfaces are covered with fibrinous membrane and granulation tissue. The difference between lung and adhesion is not apparent: everything appears on a greyish background. In the cauterization itself one has to proceed with great caution, but it is not always so difficult as imagined. The adhesions appear very thick, but their outer layer is mostly loose granulation tissue, which is easy to penetrate. During pleurisy, the net impression gained is that no operation should be performed unless there are good prospects of a decidedly favourable effect.

Other circumstances, which may influence the indications for cauterization, are the occurrence of tuberculosis in other regions, such as the larynx, the other lung and other organs of the body.

Tuberculosis of the larynx is no contra-indication. Tuberculosis in the other lung permits of cauterization only if it is necessary to continue the patient's pneumothorax. In cases of tuberculosis of other organs the same rule holds.

A summary of the indications for cauterization of adhesions will, therefore, be as follows :—

1. Cord-like adhesions up to the thickness of a little finger, found by X-ray examination, can always be burnt off, and this operation can, as a matter of fact, be done without great risk. The clinical result depends also upon other factors, of which I cannot give particulars here.
2. Membranous adhesions are similarly suitable for cauterization. The possibility of operating upon them is best decided by thoracoscopy.

3. With regard to surface adhesions, there is need for great precaution; and one should burn off only the granulation tissue which attaches the lung to the chest wall. By cauterizing the lung itself there is the risk of hæmorrhage, as well as opening up of tuberculous foci and cavities, with a consequent infection of the pleura.

CRITICAL SURVEY OF OPERATIONS SO FAR PERFORMED.

In a critical survey of the seventy-five cases which I have already published I will first consider those complications which followed operation immediately or ultimately. To begin with, we must refer to the cutaneous emphysema of greater or less degree which appears at the points of puncture of the chest wall. This complication may cause trouble for one or two days, after which it disappears and is of no further consequence. Of greater importance, however, are the pleuritic exudates which may follow operation. In the following table I have set down the various results which occurred in my cases :—

1. Cases without exudate	...	...	...	...	...	...	...	...	36
2. Cases with slight exudate	...	...	...	...	...	...	...	...	19
3. Cases with long-lasting exudate and fever (6 exudate before the operation)	...	...	...	...	...	...	...	...	11
4. Cases with long-lasting exudate with empyema (4 exudate before the operation)	...	...	...	...	...	...	...	...	7
5. Cases with exudate first appearing one to three months after operation	...	...	...	...	...	...	...	...	2
Total	...	...	...	...	...	...	...	...	75

The result in the first group of cases has naturally turned out very favourably. After a few days of fever the patients have the same low temperature as before operation. The same thing can be said of Group 2, in which we have a slight exudate which does not reach above the cupola of the diaphragm. In one or two weeks the exudate has disappeared completely. These pleurisies have, therefore, no influence on the clinical result, and one is entitled to say that the operation in four of five cases has had no unfavourable influence on the clinical progress. The third group comprises four cases in which the exudate, together with a higher temperature and apparent influence on the general condition, has continued for four to six weeks. Judged as a whole, the cases in this group had an ordinary tuberculous pleurisy.

In the fourth group, which also comprised four cases, the pleurisy developing after the operation was at first of a serious nature, and thus of the same character as in Group 3. A tuberculous empyema appeared after one or several months. In these cases the complication has had such a very unfortunate effect, that of these four cases three ended in death after one or two years, death without doubt in no small degree caused by the general condition being weakened through the chronic empyema. In the last group the condition has been good after the operation, but after a few months an exudate has appeared which in both cases turned to empyema. Nevertheless, both patients became better later on, so that the prospects for the future are tolerably good. It is impossible to decide with certainty whether the cauter-

ization had anything to do with the subsequent pleurisy. I believe that the empyema may have developed independently.

Gravesen's statistics show two cases of empyema and four of serous pleurisy out of sixteen cases. Of Holmboe's twelve cases, one had slight pleurisy and one severe, acute pleurisy and empyema with mixed infection, from which the patient died after four or five days. Taking the experience of all observers together, it would seem that pleuritic exudate and empyema are about the most serious complications of this operation. The mortality of my cases has been about 6 per cent., which is, however, a maximum figure and should hardly be attributed wholly to the operation. On the other hand, it is evident that this complication is not so grave that the method should not be used in suitable cases.

I shall now pass on to the credit side of the procedure and present in a table the results of operations in my own cases. I have arranged the results in three groups, according to the position of the adhesions in the chest cavity:—

Jacobæus:—			Number of cases.	Cauterization sufficient for complete collapse of lung.	Clinical result good.	Incomplete cauter- ization.
(a) Apex adhesions	...	10	...	9	8	1
(b) Lateral adhesions	...	62	...	44	41	17
(c) Diaphragm adhesions	...	3	...	3	1	0
Total	...	75	...	56	50	18
Holmboe	...	12	...	7	7 (?)	5
Gravesen and Saugman	...	16	...	9	7	7
Somme	...	11	...	9 (?)	7	2
Unverricht	...	7 (+ 2)	...	4 (+ 1)	4 (+ 1)	3
Total	...	121	...	85	75	35

To begin with, we have the apex adhesions. They are mostly short and practically difficult to reach with the galvanocautery. During cauterization pain is very often felt because of the proximity of the parietal pleura. In nine out of ten cases the operation has succeeded technically and resulted well clinically in eight cases. The second group, lateral adhesions, comprises the main part of the cases. In forty-four of them the operation was successful technically and in all but two was also followed by a favourable clinical result. In these two an empyema with the above-mentioned sequel developed.

In the third group, diaphragm adhesions, the technical difficulty is that the patient during the progress of the cauterization proper must hold his breath, as otherwise the adhesion will be in constant movement. What is advantageous in such cases is the fact that their cauterization is entirely painless. In all cases of Group 3 the technical result of operation was successful, but only one case turned out well clinically. The lung had extensive adhesions in the upper part of the chest, adhesions which it was not possible to remove by this method. In removing diaphragm adhesions the aim of the operation has been to get a better compression of the lung in the upper part of the chest cavity. This is, according to my opinion, possible only in exceptional cases.

Thus, the sum total of cases with clinically successful result has been fifty. Of the eleven cases in which only incomplete cauterization was possible, in one alone have I had a severe protracted pleurisy.

With regard to other authors, Holmboe had seven successful clinical results in twelve cases. Out of sixteen cases, Gravesen had nine technically successful, seven of which were sterile. Two of the patients in the incompletely cauterized cases took a change for the worse because of empyema and protracted fever. The cause seemed to be an attempt to extend the indications for operation by burning off rather extensive adhesions. Among his cases it was not unusual for the cauterization to take place at several sittings, each of a duration of one hour or more. It is evident that the danger of exudate in such cases must be rather great.

If we now summarize the results of all these 121 cases so far published, we find that in eighty-five this method has been technically and completely successful in removing adhesions which prevented complete collapse of the lung. Naturally, the clinical result has not been so favourable, as only seventy-five have been symptom-free. By again referring to the first table, we see therefore that in these cases of adhesions one can improve the prognosis so that it increases from 33.3 and 11.1 per cent. respectively, to not less than 70.2 per cent. The mortality index would, according to the same table, fall from 66.6 and 86.7 per cent. respectively to 23.4 per cent. Whether this in reality was so in the cases hitherto operated on I cannot say, partly because the time which has elapsed since the operation is too short, and partly because patients have been sent to different sanatoria and their further progress has not been under observation. A rapid survey of the facts available now would give a less favourable figure, since they point to a death-rate of between 30 and 40 per cent., which, however, of course has nothing to do with the operation itself. Many factors undoubtedly enter into play. The most common appears to have been that the patients were from the poorer classes and therefore unable to get proper nursing. The adhesion cases are often more severe than those in which a complete collapse is obtained at once.

Although it has been impossible by this method to obtain as high a percentage of clinically improved cases as in cases of simple, uncomplicated pneumothorax without adhesions, the procedure ought to be of permanent value in perhaps a limited number of pneumothorax cases with cord-like or membranous adhesions.

CASE 30.—G. C., accountant, born 1887. Onset of illness, September, 1918. Admitted to Romanäs Sanatorium, November 20th, 1918. Pneumothorax established about March 20th, 1919. During whole stay at sanatorium, temperature 37° to 38° C.: no particular improvement. Tubercle bacilli in sputum. Patient admitted May 18th, 1919, for cauterization. General condition good. Sputum purulent, about 25 to 50 c.c. daily: numerous tubercle bacilli. X-ray examination, May 19th, 1919: Pneumothorax on left side; upper lobe, left lung, not collapsed and large cavity at apex: extensive adhesions down to second rib impeded the collapse of the lung (Fig. 1). Thoracoscopy, May 20th, 1919: Lung only moderately compressed, with distinct lobuli: only one single broad adhesion with apex at uppermost limit to be seen. For some time following, frequent refillings of nitrogen given. Operation, June 3rd, 1919: Lung now considerably

more compressed, with the adhesion extending upward, more stretched: cauterization of offshoots of adhesion extending downward attempted: these cauterized together with overlying pleura on under side of adhesion: then attempts made with chisel to loosen adhesion from the parietal pleura: this apparently went well, but soon small hæmorrhage occurred and procedure was discontinued: moderately severe pain during cauterization, less during blunt dissection of adhesion with chisel—no reaction afterward. X-ray examination: Not different from last examination except for small notch in adhesion. Pneumothorax fillings continued with rather high pressure twice a week. X-ray examination, July 18th, 1919: Condition of the adhesions at the apex of the left lung on the whole unchanged. To decide presence of cavity in lateral apex or of air spaces connected with pneumothorax cavity, which might be separated by band-like adhesions, an X-ray examination was performed in high pelvic position after injection of 300 c.c. salt solution into the pneumothorax cavity. In this position all markings at apex were found denser than before, which indicated that they communicated with the pneumothorax cavity. Second operation, July, 22nd, 1919: Remains of previous cauterization noted as greyish-blue spots on lung surface at thoracoscopy. At present cauterization, tissue within adhesion found particularly firm and resistant. Cauterization as far back as possible and continued forward.

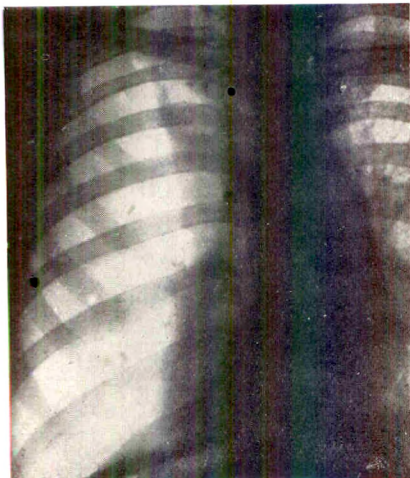


FIG. 1 (Case 30).—Apex adhesion, before the operation.

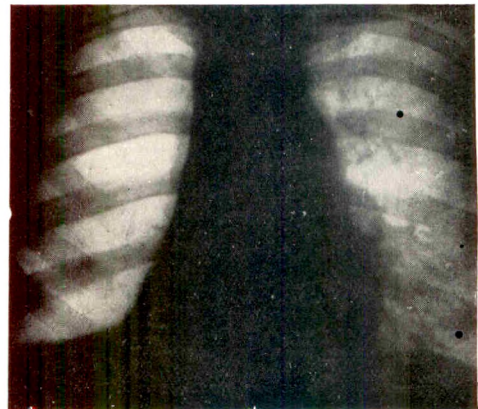


FIG. 2 (Case 30).—After the operation, complete collapse.

Suddenly an empty space appeared: this was defined in front by a short adhesion. As far upward and forward as one could reach, the thin adhesion was first cauterized. The thick adhesion became narrower and also soft and limp, upward and backward. Further cauterization was therefore impossible. For a considerable distance, and, as it seemed, enough to collapse the cavity, the lung was loosened laterally. No hæmorrhage occurred. Pains, radiating to the left arm, were now and then very severe. At X-ray examination the lung was found to be loosened right up to the middle of the dome. Patient discharged August 4th, 1919, on the whole feeling very well. Pneumothorax treatment at the dispensary continued. Cough subsequently increased a little. No marked and energetic compression was undertaken because of stomach trouble. The latter was evidently due, as was discovered later, to severe psychic shock. On September 8th, 1919, or a month and a half after second operation, patient suffered a sudden fit of shivering with fever and slight stitch in the left side. This increased, and dyspnoea set in; and, after a few days a clear exudate was found, which revealed no bacteria on cultivation. The left half of the chest was under strong tension, and on September 14th aspiration of 900 c.c. of gas brought considerable relief. During the following days, 400 to 500 c.c. gas were aspirated every day or two. Gradually the pain diminished. Temperature, which had been as high as 40° C., fell to between 38° and 39°. However, the patient's general

condition became considerably worse. Patient again admitted to Serafimerlasarett, September 25th, 1919. His condition was now bad, although since the stitch appeared in the left side his sputum had ceased. X-ray examination: Lung completely collapsed; no visible cavity; lower third of pleural cavity filled with exudate (Fig. 2). Aspiration of 1,300 c.c. thickened turbid opaque fluid September 29th. Thoracoscopy: Pleural surfaces very red and fibrinous; here and there small hæmorrhages; lung distinctly compressed and covered with fibrin; upper lobe conical with apex adherent to cupola; regions on lung surface where cauterization had been previously performed, also covered with glistening, white, fibrinous, membranous areas; no visible fistula anywhere. Later, during the autumn, typical tuberculosis empyema developed with small fistulæ on the chest wall. In spite of this, the patient's state gradually became afebrile, and by April, 1920, he had increased 20 kg. in weight. Pleural exudate had to be drawn off only at intervals of from one to two months. As far as one can judge at present, his prospects are rather good.

This case is of great interest from several aspects. Its main problem lay in the apical adhesion, which has always proved difficult of removal. This particular case was no exception to the rule. At first I tried only to loosen the pleura around the adhesions, partly bluntly with a chisel, and then attempted to get further loosening of adhesions from the chest wall by high intrathoracic pressure. This did not succeed, although high pressure was kept up for six weeks. The operation that followed was rather troublesome. The adhesions were fibrous and very short. The pain for that reason was very severe. Complete severance of the adhesion was not accomplished, but enough was burnt off to ensure complete compression of the lung. Before this was done 300 c.c. of salt solution were injected for diagnostic purposes and to decide whether we were dealing with a real adhesion and not the wall of a cavity. In this way it was made certain that there really was a cord-like adhesion. The immediate result of the operation was satisfactory, but in spite of this the patient was incapable of recovery on account of a very bad shock to the nervous system, about which we did not know anything at that time. Any attempt at stronger compression was not made. Six weeks later a violent acute serous pleurisy developed, which in time became converted into a tuberculous empyema but without mixed infection. It is a question whether the empyema was due to the operation. I have never been able to be clear about this. One would have thought that if the operation was the cause of it, the empyema ought to have appeared long before it did, as has happened in other observed cases. Further, this is not such a very rare complication in pneumothorax treatment in general. Yet, on the other hand, it is possible that after the operation a weakening of the lung wall opposite a cavity occurred, and that the infection of the pleura took place from this. In spite of all this, the case evolved favourably, with complete collapse of the lung, cessation of the sputum and marked increase of weight. Without doubt, in spite of complicating features, the operation had a highly beneficial effect.

CASE 38.—E. K., architect, aged 35. Pulmonary tuberculosis diagnosed December, 1918. Pneumothorax induced early in May, 1919. The general condition improved, but sputum containing bacilli continued. Admitted, January 19th, 1920, for cauterization. General condition good. X-ray examination: Lung broadly attached in upper part of pleural cavity down to second rib, and also by coarse, band-like adhesions to middle of diaphragm (Fig. 3); medium-sized cavity in

uncollapsed part of lung. Operation, January 21st, 1920: Thoracoscopy shows three cord-like adhesions towards diaphragm, the anterior one of the thickness of a small finger, the middle like a thick string, and the posterior one a little coarser and continuing backward as a membrane; the middle one moved particularly with respiration; above, the lung was apparently densely attached to the chest wall, but no details could be seen. Cauterization of the middle and posterior adhesions was carried out smoothly, but the anterior adhesion was rather difficult to cauterize, partly because of its fibrous nature and partly because the patient had to hold his breath every time a piece was burnt off by the cautery. The cauterization was performed without the slightest pain or hæmorrhage, but took rather a long time. After the operation a small exudate developed, which, however, did not reach above the middle of the dome. Test puncture revealed a clear, serous fluid with lymphocytes. This was negative for guinea-pigs. No rise of temperature above 37.5° . Sputum, which before the cauterization was 10 c.c. daily, gradually disappeared entirely. No tubercle bacilli on February 22nd, 1920, or afterward. X-ray examination, January 24th, 1920: Fluid to level of middle of dome of diaphragm; lung obviously better compressed; cavities above are smaller but still visible (Fig. 4).

This case is of more than ordinary interest. It was a case in which it was desired, by cauterization of the adhesions to the diaphragm, to obtain a better

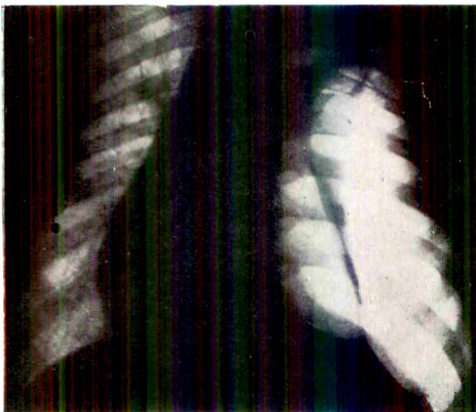


FIG. 3 (Case 38).—Adhesion to diaphragm before the operation.

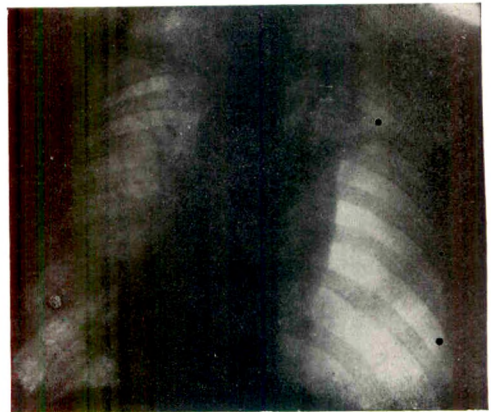


FIG. 4 (Case 38).—After the removal of the adhesion.

compression of the upper portion of the lung, which was broadly adherent to the thoracic wall. The rapid and favourable effect of the operation (freedom from sputum and bacilli in about a fortnight) showed definitely that our course of action had been right. It is also interesting to note that this improvement appeared before the visible cavities had quite disappeared. This indicates that sputum had come from other parts of the lung, which had been compressed by the cauterization. From a technical point of view the operation was rather difficult, because the actual cauterization had to be performed in small stages, during which the patient had to hold his breath each time.

BIBLIOGRAPHY.

- EDEN, R., "Operative Lösungen von Pleuraverwachsungen zwecks Anlegung eines künstlichen Pneumothorax," *Deutsch. med. Wochenschr.*, 1918, xliv, p. 798. GRAVESSEN, J., "Om Lunge-kollapsterapi ved tuberkulose med pleuraadherenser," *Akadem. Abhandl.*, Copenhagen, 1920. HOLMBOE, "Endopleural operations in pulmonary tuberculosis," *Tubercle*, 1919, i, p. 9.

JACOBÆUS, H. C., "Endopleurale Operationen unter der Leitung des Thorascops," *Beitr. z. klin. d. Tuberk.*, 1916, xxxv, pp. 1-35; *Nord. Med. Archiv.*, 1914, Avd. I, Heft 4. JACOBÆUS, H. C., *Acta Chir. Scandinav.*, 1921, liii, No. 4. JACOBÆUS, H. C., "Die Thorascopie und ihre praktische Bedeutung," *Deutsch. med. Wochenschr.*, 1921, xlvii, p. 702. JACOBÆUS, H. C., "The Cauterization of Adhesions in Pneumothorax Treatment of Tuberculosis," *Surg., Gyn. and Obst.*, 1921, xxxii, p. 423. JACOBÆUS, H. C., "The Practical Importance of Thorascopy in Surgery of the Chest," *Surg., Gyn. and Obst.*, 1922, xxxiv, pp. 289-296. JACOBÆUS, H. C., and KEY, E., "Einige Erfahrungen von operativen Eingriffen bei Lungentuberculose," *Nord. Med. Archiv.*, 1916, Avd. I, Heft 4, No. 15. JESSEN, F., "Die operative Behandlung der Lungentuberculose," *Würzburger Abhandl.*, 1915, xv, Heft 314, pp. 1-118. SAUGMAN, C., "Zur Technik der künstlichen Pneumothorax," *Beitr. z. klin. d. Tuberk.*, 1914, xxxi, pp. 571-644. SAUGMAN, C., "Medeleiser fra Veilefjord sanatorium XX," 1920. SCHOTTMULLER, "Über operative Therapie der Lungentuberculose," *Berl. klin. Woch.*, 1917, liv, p. 1123; *Deutsch. med. Wochenschr.*, 1918, xlv, p. 619. TOREK, J., "Pneumolysis interpleuralis. Ein operativer Eingriff bei der Lungentuberculose," *Deutsch. Ztschr. f. Chir.*, 1914, cxxxi, p. 132. ULRICI, H., "Künstlicher Pneumothorax durch manuelle Lösung der flächenhaft verwachsenen Lunge," *Deutsch. med. Wochenschr.*, 1918, No. 14.

Dr. S. VERE PEARSON* said that he was convinced from personal experience that a proper investigation of the nature and extent of adhesions in cases of artificial pneumothorax was an essential element in the successful treatment of these cases, and that such investigation involved in many instances inspection through the thoracoscope. The other most important means of finding out about adhesions was careful screening of the patient in the X-ray room. The patient must be in the upright position, and must be revolved so that the rays passed from different angles through the body, thereby often giving better indications of the thickness of adhesions and of the direction in which they traversed the cavity. He had looked into the pleural cavity in five cases so far. On the first two occasions it was at Veilefjord Sanatorium, Denmark, during the summer before last, just before and just after Professor Saugman had cauterized some adhesions. He had performed thorascopy himself for the first time on July 6th this year (1922). Through the kindness of his friend, Dr. Peter W. Edwards, at that time medical superintendent of the Bramcote Sanatorium, near Nuneaton, he had thorascoped some of his patients there. So little did the operation upset the patients, that they were in two instances polishing the floor of the wards in the morning the next day but one after the operations, which were performed late in the afternoon under careful local anæsthetization preceded by a small dose of scopolamine and morphia; and one of the patients actually went to sleep during the course of the proceedings. Unfortunately it was in this, the third case of the four he and Dr. Edwards had chosen at Bramcote, that the instrument failed. A short circuit developed in the distal part of the thoracoscope, and it was while attempts were being made to rectify it that the patient went to sleep with the cannula in his chest. At that time he had not got a second instrument at hand, and was not able to get the defective one repaired for many weeks; hence he had been unable to proceed to deal with the fourth patient. This was a great

* Remarks made following Dr. Jacobæus' lecture at the Royal Society of Medicine, November 22nd, 1922.

disappointment to him, because this was the case he had purposely left to the last as being a patient with a thin lateral adhesion, which he had hoped to find an easy one upon whom to perform his first cauterization. He had written last week to Dr. Edwards' successor at Bramcote to enquire for the latest news of these patients, and the following information about their condition four days ago would be of interest. All were maintaining an improved state of health fairly well. The fourth case, the patient who had not been touched, was reported to have "very little cough and sputum and his general condition is fair. . . . His exercise capacity equals about three miles a day walking." The question occurred, would this particular patient, whose long lateral adhesion was not interfering very seriously with the collapse of his right lung, have got into a materially better state now, three and a half months later, had that adhesion been cauterized? The third patient was now employed in the carpenter's shop, and "did a full day's work without resting. His general condition was most satisfactory." Now the adhesions present in this case had deterred him (Dr. Vere Pearson) from attempting cauterization, but had he had Professor Jacobaeus' experience he would have tackled them, because they seemed to be holding up the lung very definitely from a good degree of physical collapse, though, it was to be admitted, judging by clinical symptoms, they were not interrupting progress.

RADIOGRAPHY OF THE FETUS IN UTERO.

By T. I. CANDY, M.B., D.M.R.E., Radiologist, The Royal Gwent Hospital, Newport, Mon.

THE employment of X rays to demonstrate the foetus *in utero*, and as an aid in the diagnosis of pregnancy, would seem to be one of the most obvious applications of the science of radiology, yet it is a field that has been almost completely neglected. It is true that it has presented great technical difficulties to the radiologist. In most of the attempts that have been made the foetus has been very indistinctly if at all shown, a result which was of no real value from the obstetric point of view, and this explains why radiology as an aid to diagnosis has made no appeal to the obstetrician. A good skiagram, however, which shows the foetal skeleton clearly and well differentiated from the maternal bony parts, is in a different category and ought to appeal strongly, for it yields most useful information, and in many ways will be of great assistance. The writer is convinced that with attention to a few points of technique the radiologist can produce such a skiagram for his obstetrical colleague, in any case after the sixth month of pregnancy. In cases earlier than this it is more difficult, but not impossible, provided of course that ossification of the foetal skeleton has advanced far enough. The writer has obtained a skiagram showing the foetal skeleton in a case which was estimated to be about four and a half months. A skiagram in the early months would only be of value in

demonstrating the presence or absence of pregnancy, but in the later months its value would lie far more in the information to be obtained about position, etc., for clinically, in most cases, the diagnosis of pregnancy at that stage would be beyond all reasonable doubt. This is fortunate, because it is easier to demonstrate the foetus on a skiagram in the later than in the earlier months.

The main difficulties which confront the radiologist in this field of work are :—

1. The thickness of the maternal soft tissue to be penetrated causing scattering of the beam and blurring of definition.
2. The cartilaginous nature of the foetal skeleton giving poor contrast in such a thick mass of soft tissue.
3. The presence of the amniotic fluid increasing the scattering of the beam of X rays.
4. Foetal movements.

The first three difficulties are the most important, and can be overcome almost completely by the use of the Potter-Bucky diaphragm. It is not intended here to go into the technique of the use of this apparatus, as it is assumed that the worker is familiar with it. Suffice it to say that for detail and contrast in the radiography of thick parts it is, in the writer's opinion, a *sine qua non*. The fourth difficulty can be minimised, and in a great many cases removed completely, by correct positioning of the patient and by the use of a broad calico compression band not unlike an ordinary obstetric binder. Sufficient fixation of the foetus can thus be obtained, and exposures up to ten seconds have been given without movement showing. Instantaneous exposures are therefore not necessary, which is a great advantage, for instantaneous work is not always practicable.

POSITION OF THE PATIENT.

The patient should lie face downwards upon the Potter-Bucky diaphragm, with the trochanters about an inch or so above the lower edge of the film in the cassette. The chest should be well raised on pillows, and the position will not then be found to be uncomfortable. Sand bags should be placed upon the backs of the thighs.

EXPOSURE TECHNIQUE.

The anticathode of the overhead tube should be centred over the third lumbar vertebra at a distance of 30 in. from a 15 by 12 duplitized film with double intensifying screens. The patient is asked to hold her breath and at the same time to press down the abdomen firmly into the Potter-Bucky diaphragm. She will find this quite easy to do if the chest be well raised, as stated. The assistant immediately applies firm, but not vigorous, compression with the compression band, and the exposure is made usually for about five seconds, using 25 to 30 milliamperes with a spark gap of $5\frac{1}{2}$ in. The compression band is made of strong calico, 42 in. long by 12 in. broad, double

thickness. It is attached at one end to the Potter-Bucky diaphragm. It has a hem of about 1 in. at the other end, through which passes a round stick, about 14 in. long and about $\frac{1}{2}$ in. in diameter. The ends of a piece of stout window blind cord, about 20 in. long, are attached to each end of this stick. A stronger stick, about 36 in. long, is used as a lever to pull upon this cord, using the lower bar of the couch as a fulcrum. The advantage of this method is that compression can be applied in an instant and removed in an instant, with the result that the patient has only to endure the compression for the duration of the exposure. It effectively fixes the foetus and at the same time reduces the antero-posterior thickness to be penetrated. A 10 KVA transformer by X Rays, Ltd., and a fine focus Coolidge tube was used in all the cases. The exposure time of five seconds could be reduced still further by increasing the milliamperage, but it was found that the sudden blast of a high milliamperage caused the patient to give a momentary tremor, which of course detracted from the definition of the resulting skiagram. A good 16-in. coil, which will give 15 to 20 milliamperes for five or six seconds, ought to yield a satisfactory result, since the output of X rays, milliampere for milliampere, is greater with a coil than with a transformer.

DEVELOPMENT.

Too much stress cannot be laid upon the importance of this operation. One of the commonest faults in general radiographic technique, in the writer's opinion, is under-development. Density is obtained in most cases by over-exposure at the expense of the contrast. As brilliancy and contrast are essential in the radiography of the foetus *in utero*, over-exposure is to be avoided and development must be full. One should never depend upon one's judgment to tell when development is completed, as too often mistakes will arise even with experienced workers. A very trustworthy method is that recommended by Kodak Ltd., namely, development by time and standard temperature, and with a standard developer formula. It will surprise many workers, if they carry out this method exactly, to find what a great reduction can be effected in exposure time and what a great improvement in the brilliance and contrast of the resulting negative results.

Is there any danger to the foetus or to the mother from the exposure to the X rays? This is often the first question asked by the patient's doctor. In the writer's experience there is no danger at all. Of course, as in any other branch of radiography, an indefinite number of exposures should not be made. The writer has made six exposures in succession, and a further four exposures after a month's interval in one case with no ill effects whatever, subsequent labour being normal and the baby particularly healthy and vigorous.

Some of the uses of a skiagram of the foetus in utero from the obstetric standpoint :—

1. The demonstration of the foetal skeleton upon a skiagram is an absolute positive sign of pregnancy, so one more will need to be added to the list of positive signs in the text-books of midwifery. The writer has had several cases sent to him where pregnancy, though suspected by the clinician was strongly denied by the patient, and where the

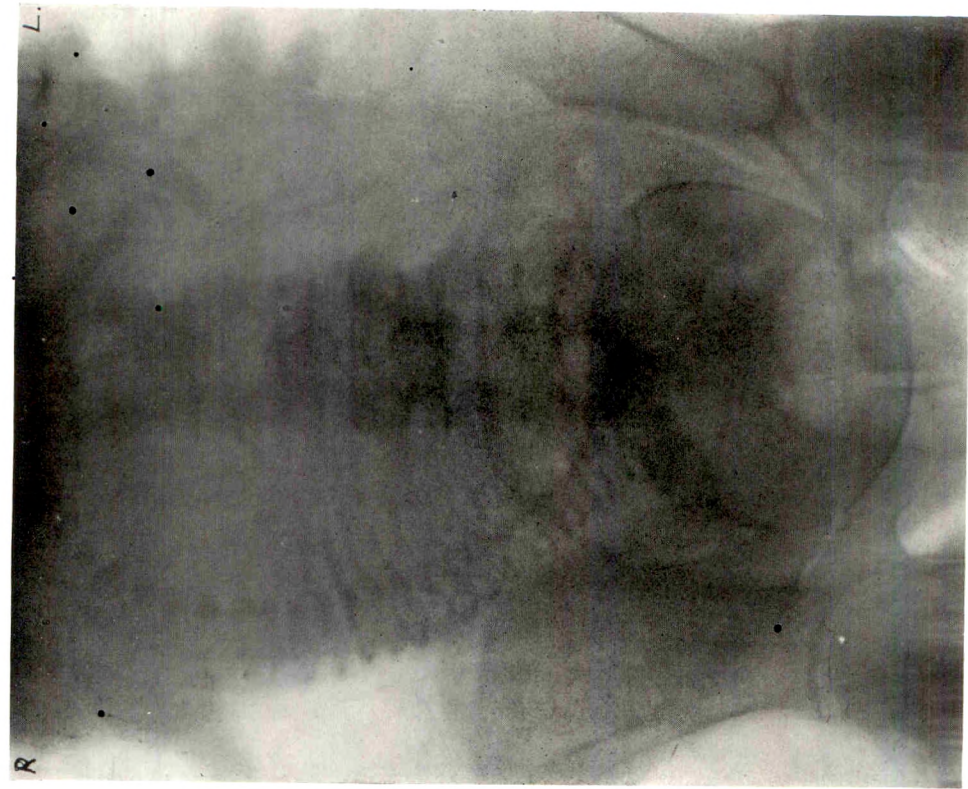


FIG. 2.—Primipara, 8½ months gestation. Head presenting and fixed in pelvis. Occiput to the right. Subsequent delivery normal. R.O.A. presentation. A healthy full time female child.

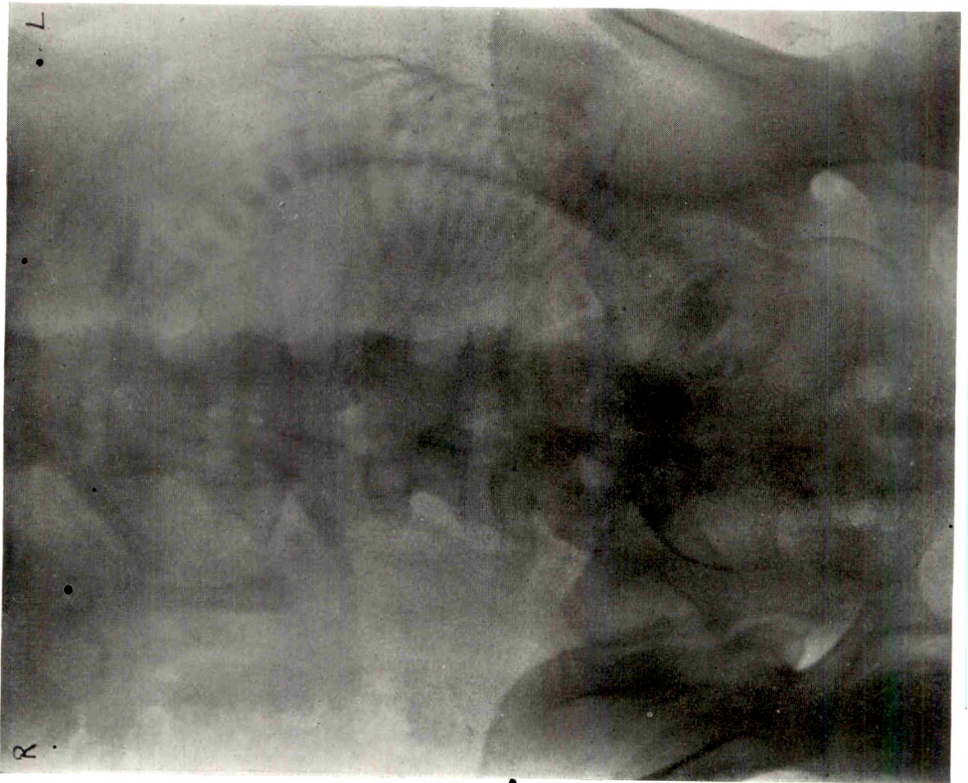


FIG. 1.—Primipara, 8½ months gestation. Head presenting and fixed in pelvis. Occiput to the left. Subsequent delivery normal. L.C.A. presentation. A healthy full time male child.

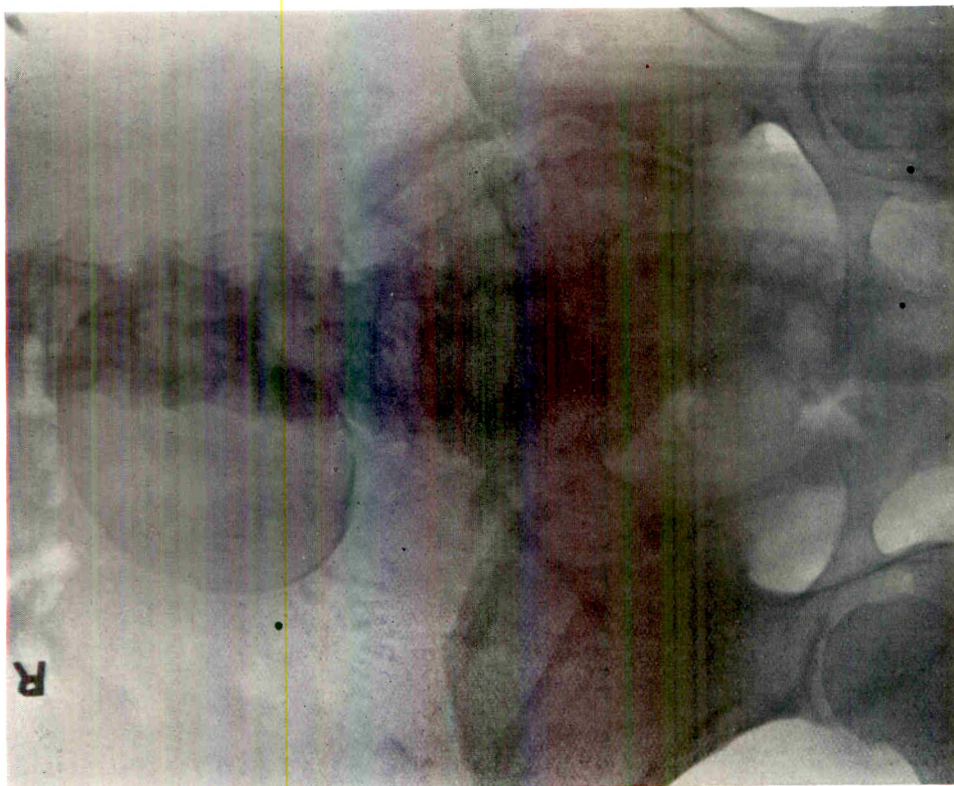


FIG. 4.—Primipara, 7½ months gestation. Breech presenting. Subsequent labour difficult. Delivered as breech. Female child, lived 24 hours. Note detail of the foetal hands.

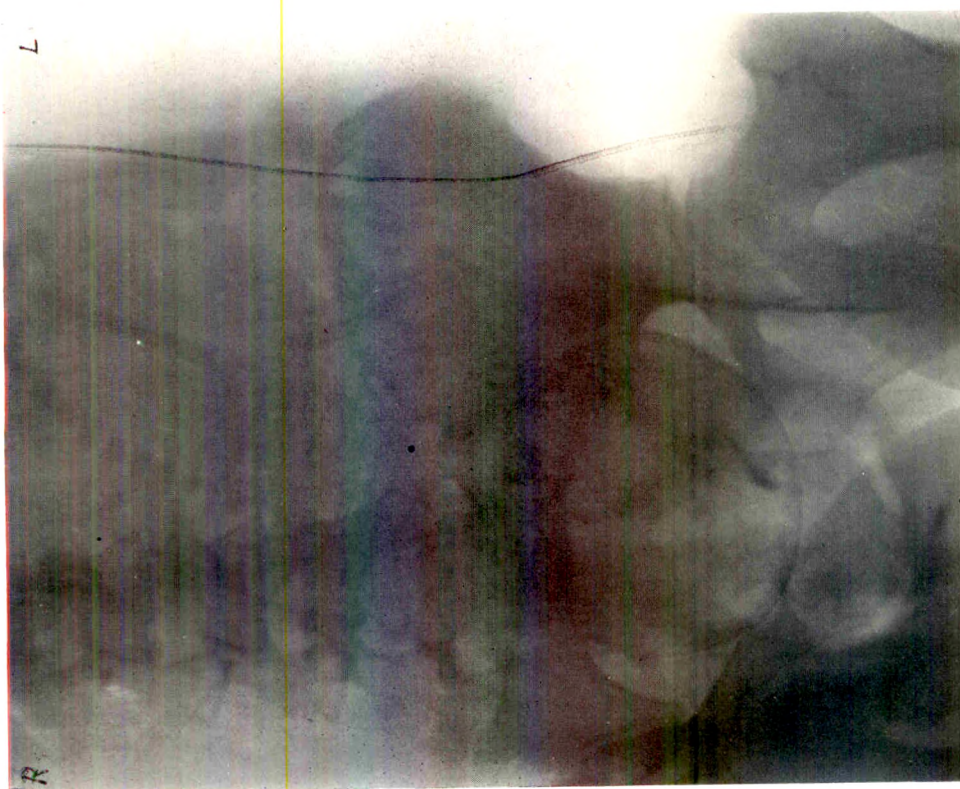


FIG. 3.—Multipara, 8 months gestation. Deformed pelvis. Head presenting but not fixed. Occiput to the right. Subsequent delivery normal. R.O.A. presentation. A healthy full time female child.

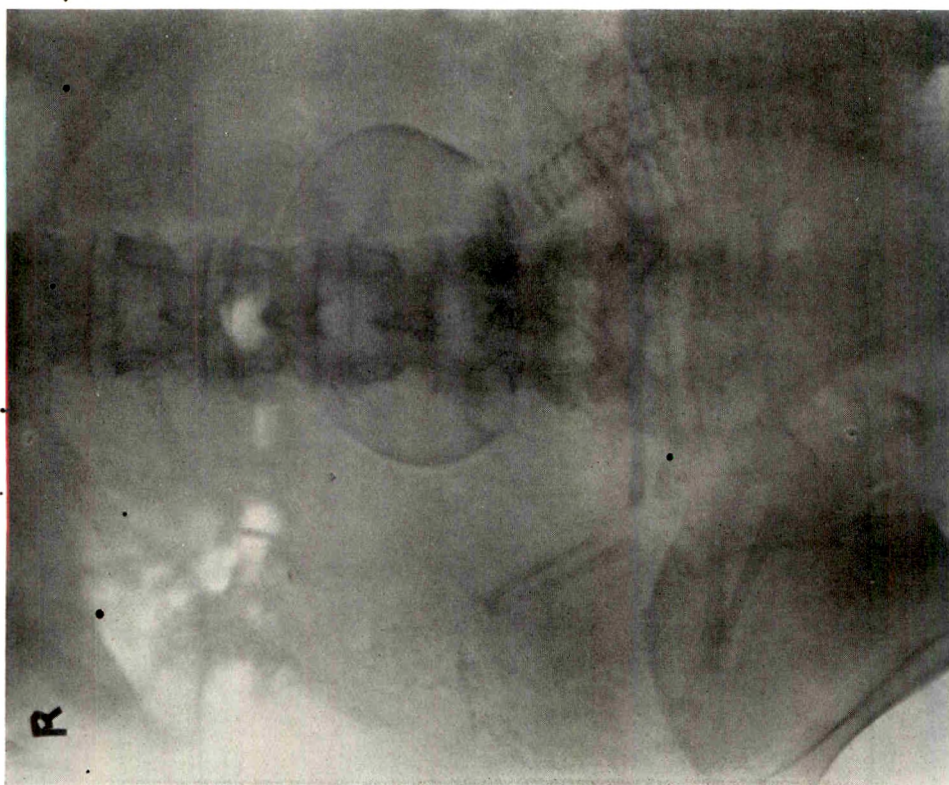


FIG. 5.—The same case as Fig. 4, taken five minutes afterwards. Note that the occiput has now rotated to the left.

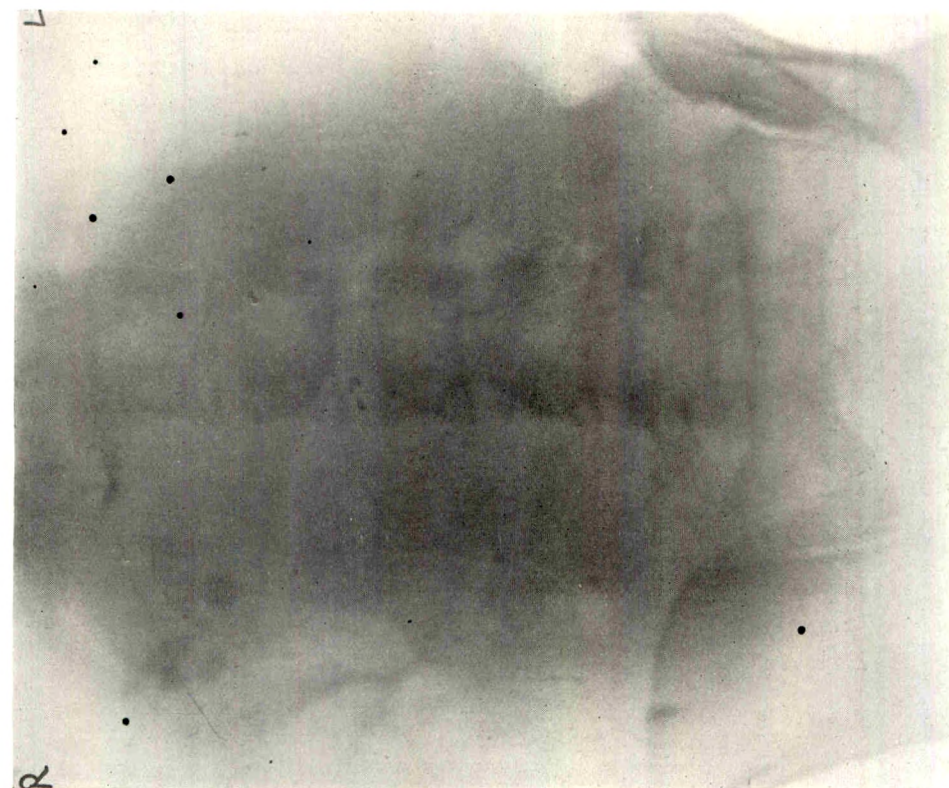


FIG. 7.—A case of a large ovarian cyst which clinically simulated a full-time pregnancy. Some calcified nodules are seen in the right hypochondrium. The radiograph definitely excluded the presence of a foetus. The lack of clearness and definition is due to the thick contents of the cyst, a point which helped in the diagnosis.

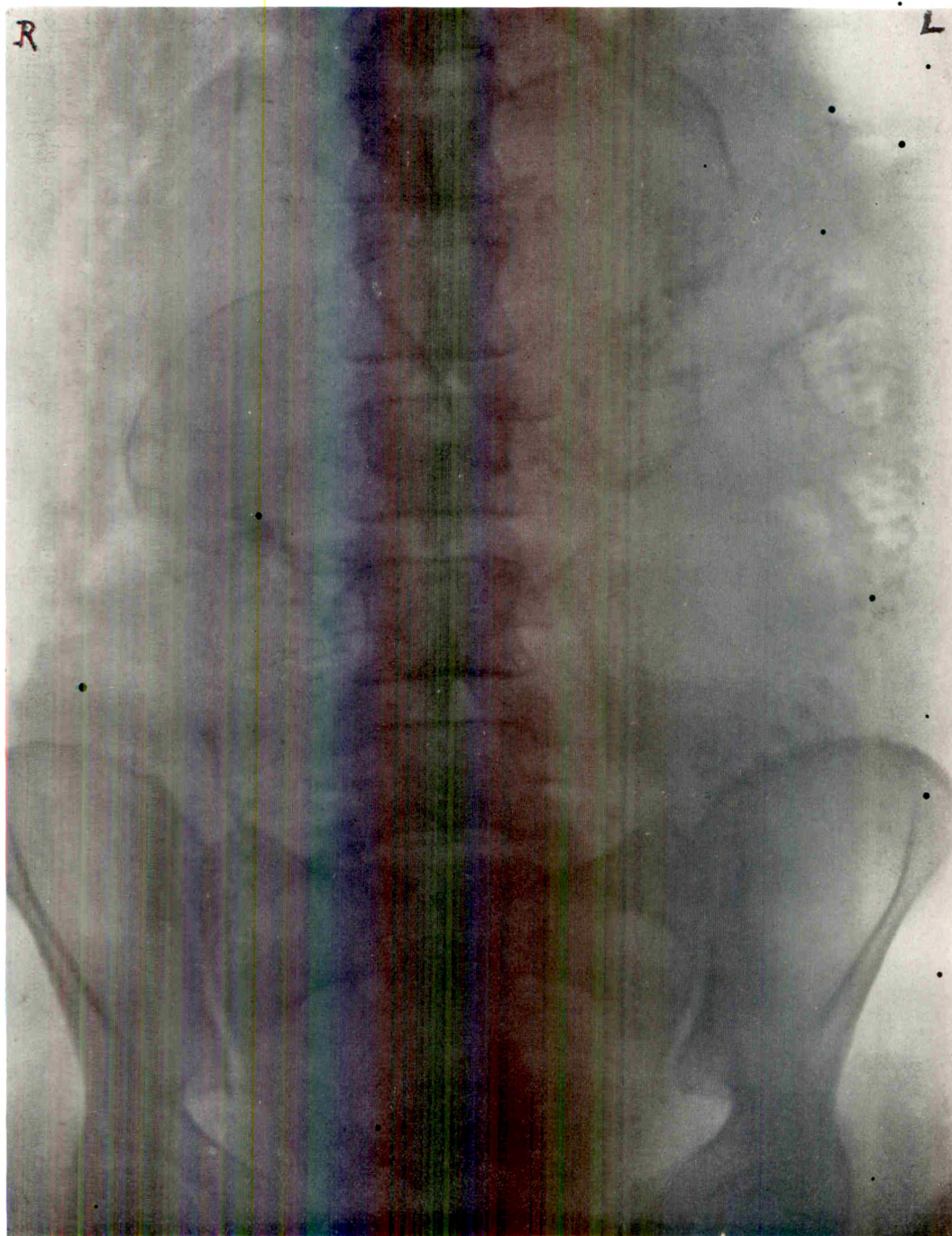


FIG. 6.—Multipara. Twin gestation $6\frac{1}{2}$ months. Double breech face to face. Subsequent labour normal, one breech and one head delivery. Healthy male and female children.

skiagram demonstrated the foetus beyond all doubt. In one case already referred to the duration of pregnancy was estimated to be about four and a half months.

2. Failure to demonstrate the foetus on a skiagram during or after the sixth month of pregnancy is, in the writer's opinion, an absolute negative sign as regards pregnancy. For example, a "full time" patient was once sent to the writer because labour showed no signs of coming on. The skiagram did not show a foetus, but it showed several small dark shadows in one flank, and an ovarian cyst with calcified matter was diagnosed, a finding which was confirmed at the subsequent operation.
3. A skiagram will give positive evidence upon the question of twin or triple pregnancy.
4. A skiagram will give useful information upon position and lie of the foetus, differentiating positively between a head, a breech, and a transverse presentation.
5. A skiagram will give useful information, though perhaps not absolute, upon the relationship of the size of the head to the maternal pelvis. More work, however, upon the radiography of pregnancy in cases of contracted pelvis requires to be done, as the writer has not had the opportunity of examining a large number of such cases. He believes that good stereoscopic skiagrams would contribute valuable information regarding all diameters.

The accompanying illustrations are examples of some of the results that have been obtained by the employment of the technique described.

An interesting point to note is the separation of the sacro-iliac joints and of the symphysis pubis. The separation at the sacro-iliac joints is the more striking of the two.

OBSERVATIONS ON RADIUM DERMATITIS.

By M. SYDNEY THOMSON, M.A., M.D. Cantab, M.R.C.P. Lond.; and CECIL P. G. WAKELEY, F.R.C.S. Eng., King's College Hospital.

Radium dermatitis, being much less common than the condition produced by X rays, has received small attention in this country, although the Americans have considered the matter in some detail.

It is only within recent years that the ultra-violet and chemical rays of the spectrum have been appreciated as the more important agents in the production of many common clinical conditions. Previously erythema solare and the common freckle were attributed to the heat of the sun. It was also noticed that certain cases of lupus erythematosus suggested that light was the determining factor in the site of the eruption. Hydroa aestivale belongs to the same group of diseases. The production of pigmentation by means of the carbon arc in the latest type of treatment in lupus vulgaris is merely another instance of the importance of the rays at the violet end of the spectrum.

Clinically the pictures produced by excessive exposure to the X rays and to radium are indistinguishable. This is to be expected when it is remembered that the gamma rays of radium are in juxtaposition in the spectrum with and overlap the X rays.

This important fact is demonstrated by the following case:—

Mr. —, æt. 65, has been handling radium salts continuously since 1904. During 1913 he noticed for the first time a little roughness of the hands; at

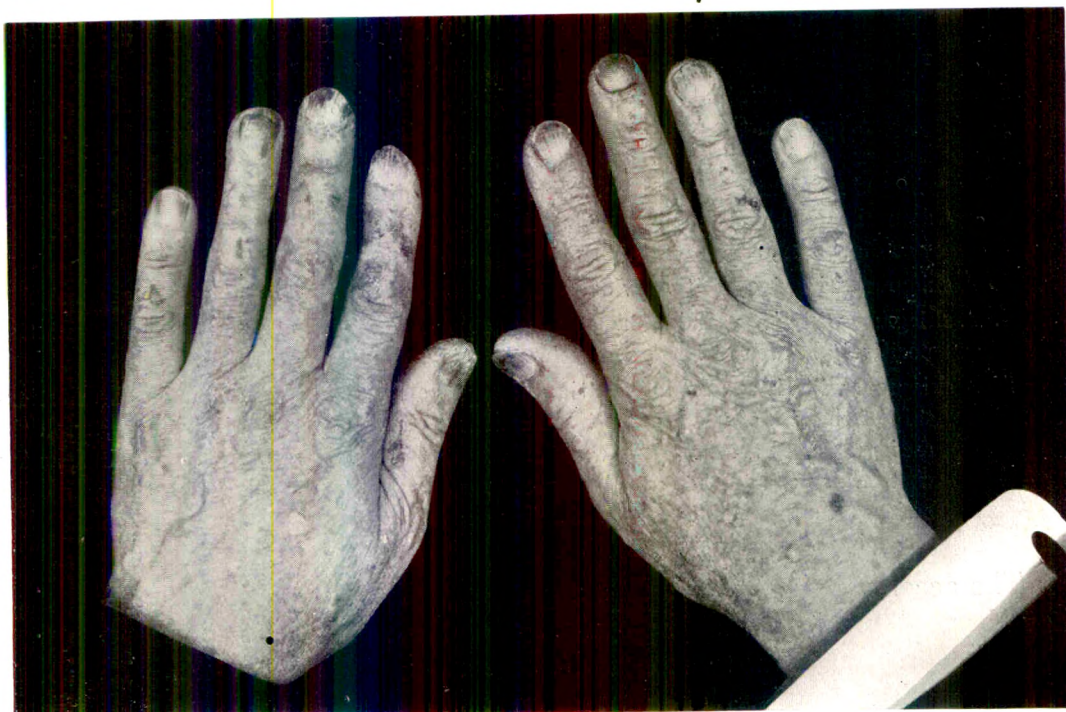


FIG. 1.—Both hands showing atrophic pigmented skin with telangiectases and warts.



FIG. 2.—Photograph showing striation and fissuring of the nails. The fingers of the left hand demonstrate the subungual hypertrophy.

the same time he experienced a tingling sensation in the fingers. The war saw a very considerable increase in the amount of material that passed through his hands, with the result that in 1916 his hands became discoloured and his nails began to fissure and were very friable. The first appearance of warts was delayed until 1920, since when they have gradually increased in number.

To-day the skin of both hands is atrophic, thin, dry and wrinkled, there are scattered about numerous small patches of lightish brown pigmentation. Dilated capillaries form a thin network over the surface. There are present numerous small hyperkeratoses, the largest being on the third digit of the left

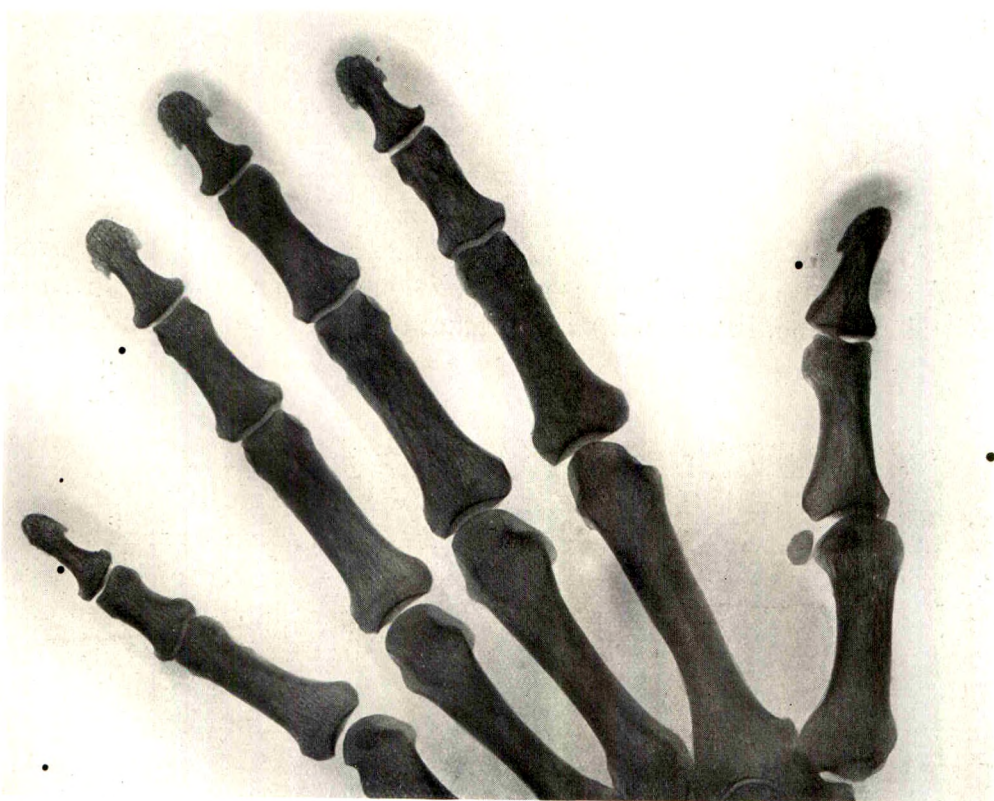


FIG. 3.—Skiagram of the left hand showing chronic periosteal changes, which are seen to be most marked in the proximal phalanges of the second and third digits.

hand, and its size being less than that of a threepenny piece. No ulcers are anywhere present. The nails are all thinned, striated, fissured and brittle. The nail bed at its free edge is markedly thickened. Great stress has been laid on this phenomenon as being characteristic of radium dermatitis, and indeed it is the only means of distinction between it and X-ray dermatitis.

As the patient complained of loss of grip, a skiagram of each hand was taken. A chronic periostitis of the phalanges was the only abnormality found. The electrical reaction of the intrinsic muscles were tested and proved to be slightly sluggish.

For histological purposes the largest wart was excised under local anaesthesia. The wound healed well.

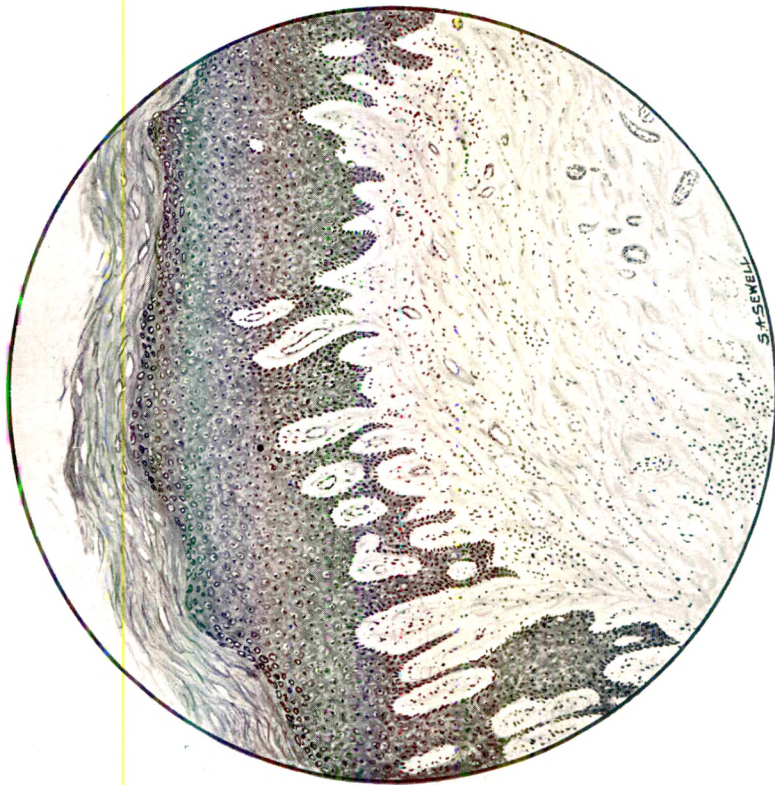


FIG. 4.—Section through skin at the margin of the excised wart. It shows hyperkeratosis and early proliferation of the interpapillary processes.



FIG. 5.—Section through the centre of the wart. It shows extensive epithelial proliferation with degeneration and vacuolation of the cells.



Fig. 7.—A section stained to demonstrate the destruction of the elastic tissue in the corium.



Fig. 6.—High-power view of the centre of the field depicted in Fig. 5. Showing early invasion of the corium by the epithelial cells.

Sutton has pointed out that radium burns, although very similar to those caused by the X rays, are less painful and heal much more readily.

The picture presented under the microscope is that of chronic inflammation, together with very early squamous-cell carcinoma. The stratum corneum is markedly thickened, but most of its cells have been lost over the centre of the wart. The stratum granulosum is not very distinct. The interpapillary processes are prolonged downwards to a marked extent, as well as showing some branching. There are numerous cell nests, and a few squamous cells can be very definitely seen to be invading the corium. The condition is one of early, but yet unmistakable malignancy. The cells in the centre of the processes are in places definitely degenerate, many others are swollen and show apparent vacuolation around the nuclei; whether this is true vacuolation or œdema of the cells is not clear. Among the prickle cells a few mitotic figures were observed. Even where karyokinesis was not evident the nuclei varied greatly in size, the larger of them presenting a most active appearance.

The superficial layers of the corium are œdematous, whilst the deeper layers show a definite increase in the white fibrous tissue. In places a slight secondary leucocytic infiltration is present. But far and away the most important feature is the destruction of the elastic tissue; in many places it is absent, whilst when present it is completely disrupted and is seen as short twisted fibrils. This striking result of excessive radiations will be better appreciated when it is realised that the accompanying figure portrays the field in which most elastic tissue was observed.

Thus, it is seen that radium and X-ray dermatitis are exactly similar and indistinguishable both clinically and histologically, except for the subungual hyperkeratosis seen in the former condition, but the matter is really even more difficult than this. Previously a brief reference has been made to the action of the rays of the sun. Many a sailor bears on his face and hands a thin atrophic pigmented skin which is clinically indistinguishable from radium dermatitis, and especially so in that warty hyperkeratoses and teleangiectases are present. This is equally true in the case of many colonials, particularly Australians. They do not need to fear sun-stroke, and so expose their heads and hands freely. In India, on the other hand, a topee is essential, and Anglo-Indians show the condition on the hands only. To these changes Sir Lenthal Cheatle has applied the name of "biotrypsy." Thus we see that all these conditions could very well be classified as "dermatitis actinica," radium and X rays being only a more extreme form of the same changes in that malignant changes supervene.

There is yet one other point which is perhaps even more curious. Many Colonials request treatment for the unsightliness produced by the warts. Strange to say, their most rapid disappearance is produced by the application of $\frac{1}{2}$ P.D. X rays. The atrophic skin is of course unaffected by this therapy.

REVIEWS.

X Rays. Fourth Edition. G. W. C. KAYE
O.B.E., M.A., D.Sc., F.Inst.P. (Long-
mans, Green & Co., 1923.)

We cordially welcome this—the fourth—edition of Dr. Kaye's book on X rays. First published in 1914, it met with an immediate success, and was at once established as the standard treatise on the subject: while the mere fact that in so short a period three editions have been exhausted, and a fourth called for, affords eloquent testimony to the sterling value of the work. Dr. Kaye possesses the happy faculty of presenting a complicated and difficult subject in the most lucid and interesting manner; and those who are reading the work for the first time will be as delighted with the fascinating style in which it is written as with the extremely clear presentation of the subject matter. It is not too much to say that the author has fully maintained the best traditions of British Science, as well from the literary as from the purely technical standpoint.

The new edition contains a great deal of additional matter, and from the 252 pages which made up the first edition, this issue has increased to 320 pages.

The fourth chapter—"On an X-ray Bulb"—contains a description of the Snook hydrogen tube, where an ingenious application of the power of hydrogen to pass through heated palladium or platinum is made use of to regulate the gas pressure in the tube.

The chapters dealing with the measurement of X rays, secondary radiations, and the various properties of the rays, have all been revised and thoroughly brought up to date.

Chapter XI—on "The Practical Applications of X Rays"—makes interesting reading, and in addition to the medical applications of the rays, an interesting account is given of some of the industrial applications of radiography. Of special interest, perhaps, is the reference to the work of Kaye and Knox during the war, when X-ray examination was applied to different parts of aeroplanes to detect flaws in the materials used in their construction. But these are not the only extra-medical uses

of the rays. A skiagram of a golf ball shows well how want of symmetry in the core may explain eccentricities in its flight. But on this interesting subject we can dwell no longer here; suffice it to say that the matter is dealt with at length in Dr. Kaye's other little book on "The Practical Applications of X Rays," of which more anon. One point in the medical section calls for a brief comment. On page 163 is a small paragraph headed "Bismuth Radiography," where reference is made to the use of opaque meals in the examination of the alimentary tract. After referring to the use of bismuth salts for this purpose, Dr. Kaye says, "Thorium oxide and barium sulphate are also used." As a matter of fact we have never known thorium oxide used in ordinary practice, while probably barium is more commonly used than bismuth on the score of expense. It may not be out of place to insert a caution here respecting bismuth salts; namely, that the subnitrate is not by any means an innocuous body, since fatal results have attended its use, owing to reduction being effected in the alimentary tract through bacterial action, with the consequent formation of nitrites, their subsequent absorption, and the production of a fatal methæmoglobinaemia. This, however, merely by the way.

Chapter XII—"On X-ray Equipment and Technique"—is written by Mr. W. F. Higgins, M.Sc., and is a carefully written and well condensed account of the general features of a modern X-ray installation.

Much new information is given in the chapter on the diffraction of X rays and crystal structure, while that on "The Nature of X Rays" has a note on Planck's quantum hypothesis.

In conclusion, we are pleased to see that Dr. Kaye has given prominence in an appendix to the recommendations of the X-ray and Radium Protection Committee, which met in 1921 under the presidency of Sir Humphry Rolleston, and of which Dr. Kaye was himself a member. The necessity for the exercise of the most careful supervision in radiological departments cannot be over-estimated.

The Practical Uses of X rays. By G. W. C. KAYE, O.B.E., M.A., D.Sc., F.Inst.P. (London: Chapman & Hall, 1922.)

Our notice of this fascinating little volume is, we fear, very belated, but a few words may appropriately come after our notice of Dr. Kaye's other book. The subject matter is largely based upon a course of Cantor Lectures given before the Royal Society of Arts in 1921, and those of us who had the privilege of hearing the lectures will again find the lecturer's genial personality revealed in this book.

Personally, we admit that we took the book up and read it through at a sitting, from cover

to cover, with unflagging interest. It is one of those choice morsels of scientific literature which are a little off the beaten track, and the perusal of which will afford many an illustrative and illuminating fact for helping those of us who are engaged in lecturing, but who have neither the profound knowledge nor the facility of imparting our own modest stores, which are the happy possession of Dr. Kaye.

This book, like the last, should be in the possession of every radiographer as well as radiologist who wishes to claim any degree of scientific acquaintance with his subject.

H. A. C.

PUBLICATIONS RECEIVED.

Book.

Sunic Bulletin. 568.

Journals.

L'Actinoterapia, September 30th, 1923.

Archives d'Electricité Médicale et de Physiothérapie, August, September, 1923.

Archivio Italiano di Chirurgia, August, September, 1923.

Archives de Médecine et de Pharmacie Militaires, April, May, June, 1923.

British Journal of Dermatology and Syphilis, October, 1923.

Bulletin of the Johns Hopkins Hospital, September, 1923.

Bulletin et Memoires de la Société de Radiologie Médicale de France, July, 1923.

Gaceta Médica Peruana, June, 1923.

Health, October, 1923.

Hospitalstidende, August 1st, 8th, 15th, 22nd, 29th; September 5th, 1923.

International Journal of Orthodontia, Oral Surgery and Radiography, August, September, 1923.

Journal of Laryngology and Otology, October, 1923.

Journal de Médecine de Bordeaux, September 10th, 20th, 25th, 1923.

Journal de Médecine de Lyon, September 5th, 20th; October 5th, 1923.

Journal of Radiology, September, 1923.

Journal de Radiologie et d'Electrologie, August, September, 1923.

Journal of the Röntgen Society, October, 1923.

Kongresszentralblatt für die Gesamte Innere Medizin und ihre Grenzgebiete, September 3rd, 10th, 17th, 24th; October 1st, 8th, 1923.

Medical Journal of Australia, July 28th; August 4th, 11th, 18th, 25th; September 1st, 1923.

Methodik der Röntgentiefentherapie vom Physikalischen Standpunkt, Band IV, 1923.

NOTICES.

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A list of collaborators at home and abroad is being prepared. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

CRANIAL RADIOGRAPHY.

By ROBERT KNOX, M.D.

(1) THE RADIOGRAPHY OF THE SELLA TURCICA.

HISTORY.

ATTENTION was first called to radiographic studies of the sella turcica in 1899 by Oppenheim, who had noted the changes produced in the region of the sella by pituitary struma, and particularly the destruction of the post-clinoid processes of the sella in a patient of his, deducing therefrom the existence of a tumour of the hypophysis, which was later verified by operation.*

Other early workers along this line were Erdheim ("Ueber einen Hypophysentumor von ungewöhnlichen Sitz," *Beitr. z. path. Anat. u. z. allg. Path.*, 1909, XLVI, 233); Kohler, "Technique de l'exploration radiographique de la selle turcique pour le diagnostic des tumeurs de l'hypophyse" (*Jour. de radiol.*, 1909, III, 5); Jaugeas, "Les rayons de Röntgen dans le diagnostic et traitement des tumeurs hypophysaires du gigantisme et de l'acromégalie," Paris, 1909, and, the same author, "The X-ray Diagnosis of Tumours of the Hypophysis" (*Arch. Roent. Ray*, 1900, XV, 87); Fuchs, "Die Diagnose des

* *Arch. f. Psychiatric*, 1901, XXXIV, 303.

Hypophysentumors" (*Jahrb. f. Psychiat.*, 1905, XXVI, 230) ; Bécclère, "Le radio-diagnostic de l'acromegalie" (*Presse med.*, 1903, II, 843), and also a number of workers in this country. A lantern demonstration of radiographic views of the sella turcica, by Thurstan Holland, was given at the Liverpool Medical and Surgical Institution on October 27th, 1910. The subject of diagnosis was entered into fully.

HARVEY CUSHING ("The Pituitary Body and its Disorders," *J. B. Lippincott Company, Philadelphia and London, 1912*) has a section on radiographic interpretations of the sella turcica. He says that there are, of course, a multitude of variations even in presumably normal states, variations which affect the position of the sella as well as its size. Needless to say, a direct lateral view on a single plate may show no trace of the pocket, for in long-standing lesions the sphenoidal region is apt to become depressed downward, so that the sella is hidden by the zygomatic areas or obscured by the shadows which are cast by the floor of the temporal fossa. Under these circumstances, stereoscopic plates are absolutely essential, and indeed they are desirable in all cases, the head being tilted slightly so that one may look directly into the fossa. Only in this way can the full depth of the pocket be clearly made out, and this is particularly true of lesions associated with ballooning of the sella floor, which has allowed the gland and its capsule to project far into the sphenoidal cells. It is often necessary to make repeated exposures from different points of view, for it is disconcerting to secure a negative which discloses a well-formed, though displaced and thinned-out sella turcica, when previous ones have seemingly shown a complete obliteration of the structure.

This has been Cushing's experience in one or two instances in which sub-temporal decompressions have been performed owing to the presence of general pressure symptoms, and a subsequent radiogram has brought into clear outline a previously obscured sella.

Profile radiographic measurements exceeding 15 mm. antero-posteriorly and 10 mm. in depth may be looked upon as indicating an enlargement, and the adult peripheral dimensions may vary from a sella of this size to one considerably over 30 mm. The skeletal measurements given by Arthur Keith for the normal average 10 to 12 mm. antero-posteriorly, 14 to 15 mm. transversely, and 8 mm. in depth. A slight magnification usually occurs on the X-ray plate. Usually a greatly enlarged sella turcica may be expected when neighbourhood symptoms are pronounced, though, as stated, this is not necessarily true of primary interpeduncular tumours. With an undistended sella there is often a single clear basal outline, but a double contour is often apparent when there has been any considerable distension of the fossa. The inner line corresponds with the lateral openings of the fossa ; the outward and lower with the downward median bulge of the sella floor. The lower line will ultimately disappear or become indistinct when the distended floor has undergone absorption from pressure atrophy. However, even with extreme thinning of the base, good stereoscopic plates will often show a trace of this outer line bulging downward almost to the floor of the sphenoidal cells.

Under such circumstances the operator need not expect to enter recognisable sphenoidal cells in approaching the gland from below, for as soon as the anterior sphenoidal wall is opened he will come directly upon the gland, covered with little more than thinned scales of bones and mucosa. Needless to say, too, the lower of the curvilinear lines will be seen to have disappeared from a negative taken after a sella decompression.

It is the writer's impression that single-plate exposures should be made by focussing directly for the hypophysis perpendicular to the sagittal plane, whereas stereoscopic exposures should be made from the side and above, so that one may look down into the fossa.

Although the patients in the author's series have been under observation for a comparatively short space of time, it has been noted in the interpretations of the case reports that a measurable progressive enlargement of the sella occurred in one or two instances. It is presumable that the serial radiograms may under some conditions be of value in determining whether or not the hypertrophic condition of the gland is advancing. Could this have been determined in some of the cases in the series, and a proper decompression of the base of the sella have been performed, the patients might have been spared their present loss of vision, often the most depressing symptom of the malady.

As a result of pressure absorption, defects will be found in the base of the sella; and with successful stereoscopic plates they may actually be seen in favourable cases. They may be multiple, or there may be a single median opening. Such defects in the sella base have been found in some museum preparations of acromegalic skulls, and were interpreted as indicating a persistent cranio-pharyngeal canal, a conclusion which must be accepted with reservations, inasmuch as a histological examination of the contents of the canal is necessarily precluded in the dried specimens.

FEARNSIDES (*Royal Society of Medicine Proceedings, Electrotherapeutic Section*, Vol. VII, p. 46, 1914), dealing with diseases of the pituitary gland and their effect on the shape of the sella turcica, points out that if an enlargement of the gland takes place, either the diaphragm or sella must be freed from its attachment to the clinoid processes, or the bony walls of the fossa must be eroded. In either case the outline of the base of the sella turcica will be altered by disease of the contained pituitary body, and a skiagram will give no definite evidence of these changes. In the skeleton the measurements of the normal pituitary fossa, as given by Keith, average antero-posteriorly (inter-clinoid distance) 10 to 12 mm., 14 to 15 mm. transversely, and 8 mm. in depth. In profile radiograms, measurements exceeding 15 mm. antero-posteriorly and 10 mm. in depth, may be looked upon as indicating an enlargement. With an undistended sella the floor of the base of the fossa in the skiagram should show a single clear basal outline. The author brings twelve cases under notice, and describes the radiological findings in each, and concludes that radiographic proofs of the changes in the conformation of the sella turcica help to make the diagnosis of pituitary disorder more certain than in other intracranial conditions. In doubtful cases a change in the size or shape of the sella

turcica, as seen in the X-ray plate, is at present the most certain evidence of pituitary disease.

GILBERT SCOTT (*Ibid.*, p. 58) states that sella deformations are merely of accessory value to the symptomatic manifestations. He gives the same skeletal measurements for the normal sella turcica as Fearnside's (see *supra*), and adds that in the skiagram there is a little increase of the actual size, this being due to the distance of the sella turcica from the plate. It must be remembered that the clinoid processes possess each two "horns" and a broad base. Thus, it is important that the view taken is absolutely lateral so that the "horns" coincide, otherwise a wrong impression will be given of the shape and size of the fossa. This correct lateral view is the most difficult part of the technique. To obtain an absolutely lateral view of the fossa it is essential that (1) the tube be accurately centered through the sella; (2) the base of the patient's skull be horizontal; and (3) the plate be vertical; that is with the patient upright. There must be no movement on the patient's part, and the exposure must be correct. The author uses a special form of apparatus for these examinations, the same as that used for the localisation of foreign bodies in the eye. The patient sits in a chair, with the side of the face against a cylinder, the diaphragm of which measures 6 in., and the length is such that the distance from the anode to the patient is 12 in. The end of this cylinder is covered with parchment; this gives better support. Fixation of the head is obtained by means of (1) a head-rest; (2) a chin-rest; and (3) a mouth-piece, which is firmly gripped by the teeth. The plate is held in position by a carrier from above. The tube is accurately centered through the cylinder, and the patient's head is carefully adjusted, so that the central ray passes through a known spot on both sides of the head. The centering of these "known spots" is carried out by placing lead shot on each side of the head, 1 in. in front, and $\frac{1}{2}$ in. above the external auditory meatus, and by a screen examination getting these to coincide accurately. These should be removed before the exposure, otherwise they will obscure the sella turcica. Stereoscopic views are not of much assistance in diagnosis.

FINZI (*Ibid.*, p. 62) also points out that it is very necessary to get the rays through the fossa exactly lateral. The method he employs is to make the patient lie down with his head on one side, with the tube beneath the couch, and the screen over the patient's head. He puts a sixpenny piece in each ear, and by moving the tube about, the images of the coins can be superimposed, one of them appearing as a halo round the other, and the central ray is then coming through the external auditory meatus. To get it opposite the pituitary fossa he moves the tube forwards 1 in., and upwards 1 in. The base of the skull is not exactly transverse to the couch, so by moving the tube box upwards an inch he moves the rays an inch above the base of the skull. This brings the central ray exactly opposite the pituitary fossa.

HAMPSON (*Lancet* 1, 1914, p. 714) offers the following suggestion for centering the sella in the directly transverse rays from the tube. He takes two metal curtain rings of about $1\frac{1}{2}$ in. in diameter, and attaches to each two

small strips of adhesive plaster. He fixes them by these strips in their proper position with reference to each auditory meatus, and then arranges head and tube so that the screen shows the rings concentrically placed, one apparently within the other. The central rays will then be truly transverse and unobstructed, and the shadow of the rings on the plate will prove the fact.

JOHNSTON (*Amer. Jour. Roent.*, 1914, p. 172) has investigated the radiography of the pituitary body in its relation to epilepsy, and finds that in a certain class of cases—those who, with previously good histories, between the ages of fifteen and thirty-five begin to develop epilepsy—decided departures from normal in the topography of the sella turcica were often demonstrable. The changes for the most part consisted of an overgrowth and folding over of the clinoid processes, especially the posterior, thus causing a decided difference in the size of the pituitary fossa, and therefore in the gland itself. The author considers that the frequency with which these changes were to be found was striking.

JOHNSTON (*Amer. Jour. Roent.*, Vol. IV, p. 555, 1914) thus sums up his conclusions as to X-ray observations of the pituitary region in intracranial lesions: The first requisite for study of intracranial lesions, particularly of the sella, is a wide familiarity with the roentgenograms of the normal conditions, and mastery of a technique resulting in uniform production of roentgenograms of unusual definition and excellence. There is a wide variation in size and character of the sella which must be considered within the limits of the normal. Idiopathic epileptics in a large proportion of cases show definite changes in the region of the pituitary fossa. Pituitary struma manifests itself by deformation and destruction of the sella, rarely by visualisation of the tumour itself. Intracranial tumours other than those of the pituitary frequently so manifest their presence as to permit of their detection by roentgenography. Every patient showing evidence of optic atrophy, bitemporal hæmianopsia, papilloedema, or loss of vision, is entitled to a careful roentgen exploration of the sella and intracranial region. The author prefers finely focussed heavy anode (transformer) tubes of the hydrogen type, working at a voltage not exceeding 60,000, and usually less, with an exposure of 200 ma. seconds and fairly fast plates with fine grain. In addition to the lateral plates of the skull, it is advisable to make at least one plate involving the use of the long tubular diaphragm, having a diameter not greater than $2\frac{1}{2}$ in., and a length of at least 8 in., since unexpected detail is frequently developed on such a plate.

SCHUELLER (*Allg. Chr. de Gehirnkrankheiten*, 1914, No. 339) describes the changes in the region of the sella as follows: Intraseellar tumours of the hypophysis cause a widening and deepening of the sella of such a nature that its floor is thinned, and approaches near to the floor of the middle cranial fossa; further, the dorsum sellæ is thinned, displaced backwards and may appear lengthened. The transition of the contours of the dorsum sellæ into the planum sphenoidale forms an acutely-angled prominence. The anterior clinoid process appears normal, or pushed upwards, and its

under surface either hollowed out or abnormally plump. The remaining part of the skull frequently shows the changes of acromegalia (thickening of the wall of the skull, bony ridges, and enlargement of the pneumatic spaces). Extra-sellar tumours of the hypophysis cause a flat dish-like widening of the sella, whereby the dorsum sellæ is thinned and shortened, the anterior clinoid process sharpened and shortened, the tubercle of the sella eroded, so that the floor of the sella is not alone thinned but, approaching slightly to the floor of the middle cranial fossa, appears to fuse in an obtuse angle with the planum sphenoidale. The remaining part of the skull shows no acromegalic changes, but rather a thinning of the walls due to an increase of the intracranial pressure. Very large tumours of the hypophysis cause a total destruction of the body of the sphenoid. In this stage it is impossible to differentiate those of intra- and extra-sellar origin; at best the condition of the anterior clinoid process, together with the other changes in the skull, points the way. (Translation in *Amer. Jour. of Roent.*, Vol. IV, p. 559, 1914.)

PFÄHLER (*Amer. Jour. of Roent.*, April, 1917, p. 193) points out that the study of the lateral aspect of the sphenoidal sinuses requires also that the sagittal plane of the skull be brought accurately parallel to the plane of the plate, that the central ray from the tube be perpendicular to the sagittal plane, and that the perpendicular ray be passed through the centre of the pituitary fossa. In the comparative study of the frontal, sphenoid, maxillary and ethmoid sinuses on the two sides in the vertical plane, it is also necessary that the central ray be passed directly through the sagittal plane of the skull and exactly in the median line, and that this plane be kept absolutely perpendicular to the plate. If this is not done, the superimposed shadows of the posterior portions of the skull and spine become confusing, and there can be no exact comparison. The author goes on to describe a head leveller which he has designed for the study of the pituitary fossa and the accessory sinuses, and which can be applied either in the recumbent posture or in the vertical position.

HEUER and DANDY (*Bulletin of the Johns Hopkins Hospital*, XXVI, No. 309, p. 311) set forth certain conclusions on roentgenography in the localisation of brain tumour, based upon a series of one hundred consecutive cases. They believe that, with the exception of the comparatively few which show definite tumour shadows, roentgenograms of the head are merely an aid, though an important aid, in the diagnosis of brain tumour. Uncalcified tumours do not cast shadows in the roentgenogram unless tumour tissue has invaded the accessory sinuses. A possible exception may be hypophyseal lesions, which are viewed against the dark temporal fossa. Calcified or bony tumours cast shadows which are readily recognised. In the authors' experience such shadows occur in 6 per cent. of patients with bone tumour. The signs in the skull of increased intracranial tension, *i.e.*, enlargement of the skull, separation of the cranial sutures, general convolutional atrophy, and destruction of the sella turcica, have a considerable value in the differentiation between cerebral and subtentorial lesions, for they indicate an internal hydrocephalus, rare in cerebral tumours, but a usual accompaniment of

posterior fossa tumours. The local changes in the skull due to brain tumour are of the greatest value in the diagnosis of hypophyseal or supra-sellar lesions. Local hypertrophy of the skull over cerebral tumours is of definite diagnostic value in 4 per cent. of the cases. Local atrophy is of equal value. Local unilateral vascular changes have diagnostic significance. Local convolutional atrophy is of importance. In about 45 per cent. of the cases roentgenography has been of real diagnostic value.

CARR (*Amer. Jour. Roentgenol.*, August, 1917, p. 405) discusses the changes in the sella turcica in cases of brain tumour. Such changes, he says, may be caused by direct or indirect pressure. Direct pressure effects are produced by hypophyseal or supra-sellar tumours. As the diagnosis of these two types of tumours by radiography has become so exact, she only presents the results of her investigations of the indirect pressure effects upon the sella, by an internal hydrocephalus produced by tumours in the posterior fossa of the skull. Thirty-two verified cases of cerebellar tumours were studied, and only three failed to show pressure effects upon the sella. In these three cases the distension of the sutures and atrophy of the convolutional impressions were so marked as to account for the negative sella findings. The changes in the sella vary from a slight haziness of the dorsum sellæ to an enlargement of the fossa, not, however, to the degree seen in the hypophyseal tumours. The dorsum sellæ may be pressed forward, forming an acute angle with the floor of the fossa. From a slight general haziness of the fossa, the signs may change to those of a very moderate degree of pressure atrophy of the dorsum sellæ, and even to a destruction of the entire dorsum and posterior clinoid processes, and a marked pressure atrophy of the posterior part of the floor of the sella. The anterior clinoid processes rarely show signs of pressure atrophy. The change in the size of the sella is demonstrated by the increase in width of the entrance and deepening of the fossa, the floor in some cases reaching the lower level of the sphenoidal cells.

TECHNIQUE.

The X-ray examination of the sella turcica is one of exceptional difficulty when exact measurements have to be made. This is due largely to the difficulty of the technique and the absence of any attempt at standardisation. In making precise measurements a certain amount of deduction is required, because of the central position of the sella turcica at the base of the skull, and its consequent distance from the photographic plate or film. This need be no real difficulty, because in all skulls the distance will be practically the same, and if the normal average measurements are ascertained, it is easy to calculate the difference in an average number of radiograms examined and to make allowance for that difference.

In the technique, if a fixed distance be adhered to between the anticathode of the tube and the photographic emulsion on the plate, another factor which causes confusion is eliminated. Attempts have been made to provide a standard head rest, and one of the best is that recommended by Pfahler.

Stereoscopic radiography is recommended for the study of the sella turcica, because it is in this region that it is likely to be of great value. Single negatives give but a poor impression of the depression and its anatomical relations. In estimating enlargements of the sella, it is necessary to consider the transverse diameter as well as the antero-posterior and the depth. A stereoscopic pair of negatives enables the observer to arrive at some sense of the width, and when these three diameters are available it is possible to make a diagnosis of enlargement or the reverse. Radiography of this region is not at all easy if very accurate technique is not employed. The determination of the best point at which to centre the tube is one of the most important steps in

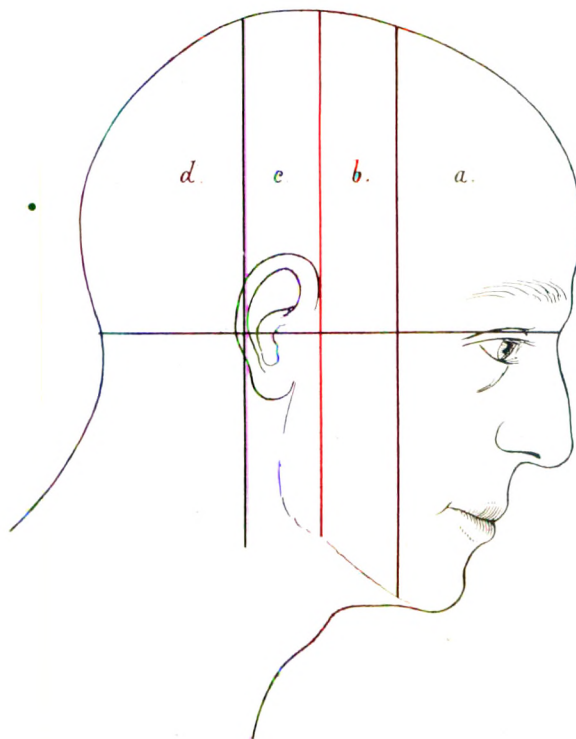


FIG. 1.

the technique. This alone has been the means of inducing several workers to endeavour to furnish a definite point. Finzi, already referred to, gives a very good screen method. In order to introduce a definite series of positions, the writer, in collaboration with Dr. R. W. A. Salmond, worked out and published in the ARCHIVES, in 1915, a preliminary paper on "A System of Topography for Use in Radiography of the Head." It will simplify the descriptive part of these articles if the substance of this paper is included in this the first of a series on Cranial Radiography; the subsequent technique to be described will in large part be based on a clear conception of the radiographic base line and the perpendicular lines in relation to it.

An attempt has been made to outline a simple method of measurement to

show the relations between the surface of the head and the bony as well as the soft parts in the interior.

The method is based on a series of measurements made on the dry skull, and afterwards applied to and verified on subjects in the post-mortem room, and also as far as possible on the living subject.*

In our experience it is accurate for application to the various types of skull met with, though in exceptional yet still normal types its accuracy will be lessened.

A base line, which may be called the radiographic base line of the skull, is made use of. It is determined by drawing a line from the nasion, *i.e.*, the mid-point of the suture between the frontal and nasal bones, through the centre of the external auditory meatus, and continuing it to the mid-line at the back of the head (Fig. 1). The length of this is measured, and on it three points are marked, at the one-third, the one-half, and the two-thirds distance from either end; usually it is most convenient to measure from the front.

Through these points perpendiculars to the base line are drawn, dividing the head into four areas, by three lines which run downwards and forwards and are intersected by the base line (see Fig. 1). The lines may be marked on the head with a skin pencil, or by thin wire if they are to be reproduced on the plate. This base line was chosen because the nasion is a fairly constant point and easily determined; the external auditory meatus is also constant, and the whole line corresponds exceedingly well with the base of the skull.

The external occipital protuberance was avoided because it is variable and not always easy to feel, and moreover, a line between the nasion and the external occipital protuberance does not correspond to the base of the skull as well as the one chosen.

RELATIONS OF THE RADIOGRAPHIC BASE LINE OF THE SKULL.

The following points are found on the same horizontal plane as the base line (Fig. 2): (1) The lower part of the Frontal Sinus; (2) Sphenoidal Sinus; (3) Apex of the Petrous bone; (4) Clivus of the Sphenoid; (5) Glenoid cavity and Condyle of the lower jaw; (6) External auditory meatus; (7) Jugular Foramen, and (8) Mastoid Process.

The point of intersection at the one-third distance from the nasion is at the zygomatic malar suture, and corresponds in the interior with the front part of the sphenoidal sinus. The point at the one-half distance is at the glenoid fossa and condyle of the lower jaw, and corresponds in the interior with either the lower part of the dorsum sellæ or just a little behind it, the apex of the petrous bone. The point at the two-thirds distance is on the mastoid process, towards its posterior margin, and corresponds with the curved portion of the lateral sinus in the interior.

If in the interior of the skull a mesial base line is drawn between the ends

* We wish to thank Professor Keith for kindly allowing measurements to be made on several skulls in the Museum of the Royal College of Surgeons, and Dr. E. H. Shaw for allowing measurements to be made and verified in the post-mortem room of the Great Northern Central Hospital.

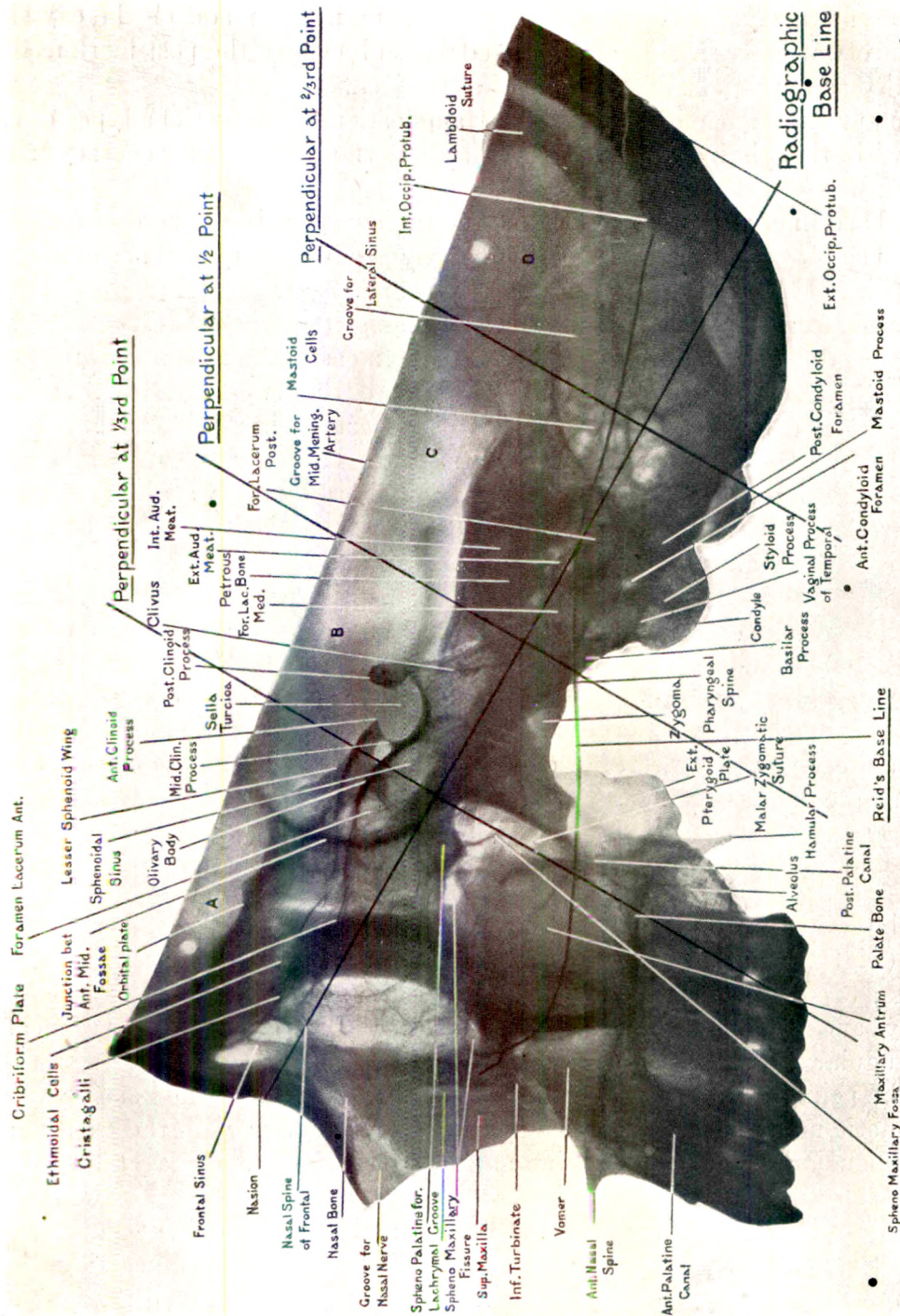


FIG. 2.

of the corresponding base line on the exterior, it will be found that the intersecting lines at the one-third and at the one-half distance correspond in both cases, but that the intersecting line at the two-thirds distance on the exterior base line corresponds to a point at the three-quarter distance on the mesial line in the interior.

RELATIONS OF THE PERPENDICULAR LINES AND THE AREAS DEFINED BY THEM.

The perpendicular at the one-third distance corresponds with three sutures of the skull, the coronal, the squamo-sphenoidal, the sphenomaxillary, in order from above downwards. It bisects the frontal lobe of the brain, and roughly divides the face from the cranium.

The perpendicular at the one-half distance approximately corresponds at its upper part with the fissure of Rolando, and below the base line with the posterior margin of the ascending ramus of the lower jaw.

The perpendicular at the two-thirds distance bisects the parietal lobe of the brain.

These three lines divide the head into four regions, which may be called A, B, C, D, from before backwards (Figs. 1 and 2).

Region A contains the anterior fossa of the skull with the anterior half of the frontal lobe, the orbits and the facial bones with the exception of the ascending rami of the lower jaws and the palate bones.

Region B contains the body of the sphenoid and the greater part of the sphenoidal sinus, the sella turcica and pituitary body, the palate bones and ascending rami of the lower jaw, the posterior half of the frontal and the anterior part of the temporo-sphenoidal lobe of the brain.

Region C contains the mastoid process, petrous temporal bone, occipital condyles, anterior half of the parietal and posterior part of temporal lobes of the cerebrum, the pons, medulla, and anterior part of the cerebellum.

Region D contains the horizontal portion of the lateral sinus, the occipital lobe and posterior half of the parietal lobe of the cerebrum, and the posterior part of the cerebellum.

As an illustration of the use of the system: To radiograph the sphenoidal sinus laterally. The system shows that the base line runs through the sinus, and that it is situated between the intersecting lines at the one-third and one-half distance. The tube is therefore arranged so that its central rays pass through the base line and between the intersecting lines.

The technique necessary in this system of measurement need be only briefly indicated.

The patient may be radiographed with the head in either the vertical or horizontal position; if necessary, one of the many head rests may be used to steady the head in either position. The sagittal suture should be parallel to the plate, a point of importance in order that a region localised on one side of the skull may exactly correspond with the similar region on the other side.

The side to be radiographed is placed next to the plate, the opposite side being made use of for the localisation of the point through which the central

ray passes. When in proper position the tube is centered over the base line of one side, and the two lines will be found to coincide exactly ; or if the tube is centered over the perpendicular drawn at the one-half distance, then both perpendiculars at that point on the two sides of the head will be found to coincide.

In the localisation of bullets or shrapnel in the brain, this system may be used in conjunction with the cross-thread method of Sir James Mackenzie Davidson. It can also be used in conjunction with the ordinary stereoscopic method, the resulting negatives or prints being viewed from the point chosen before the tube was shifted to either side.*

THE SELLA TURCICA AND ITS ANATOMICAL RELATIONS.

"The body of the sphenoidal bone is more or less cubical in shape. It is hollowed out in its interior to form two large cavities, the sphenoidal air sinuses, which are separated from each other by a septum. The superior surface of the body presents in front a prominent spine, the ethmoidal spine, for articulation with the perpendicular plate of the ethmoid ; behind this is a smooth surface slightly raised in the middle line, and grooved on either side for the olfactory lobes of the brain. This surface is bounded behind by a ridge, which forms the anterior wall of a narrow transverse groove, the chiasmatic groove (optic groove), above and behind which lies the optic chiasma ; the groove ends on either side in the optic foramen, which transmits the optic nerve and ophthalmic artery into the orbital cavity. Behind the chiasmatic groove is an olive-like elevation, the tuberculum sellæ, and still more posteriorly a deep depression, the sella turcica, the deepest part of which lodges the hypophysis cerebri, and is known as the fossa hypophyseos. The anterior boundary of the sella turcica is completed by two small eminences, one on either side, called the middle clinoid processes, while the posterior boundary is formed by a square-shaped plate of bone, the dorsum sellæ ending at its superior angles in two tubercles, the posterior clinoid processes, the size and form of which vary considerably in different individuals." (Gray's "Anatomy.")

MEASUREMENT OF THE SELLA TURCICA.

The radiographic outline of the sella is in all instances enlarged, because of the distance it lies from the surface of the plate. This is a constant factor and can be allowed for in all calculations. If all radiograms are made under standard conditions in regard to position of the head, distance between tube and plate, and a definite centering position is used, then it will be possible to make fairly reliable measurements in a large number of cases. A tracing of the sella should be made from the negative and the measurements made from the following points :—

1. A posterior point on one anterior clinoid process or approximately a point between the two, backwards to the most anterior point on the posterior clinoid process, the interclinoid distance, Fig. 3 A.

* Knox and Salmond, ARCHIVES, April, 1915.

2. A line from the anterior to the posterior part at its longest diameter will give the antero-posterior measurement. This would appear to be the more satisfactory line, since the interclinoid itself may vary considerably in normal cases, Fig. 3 C.

3. A line drawn from the mid-point of the line joining the two bony points, to the deepest part of the sellar recess will give the depth, estimated by Keith on the average dry skull as 8 mm., Fig. 3 B. A small metal scale may be fixed to the patient's skull just above the upper level of the sella. This will appear on the plate and allow of the measurements being read off at once. If this is done with a stereoscopic pair, the measurement may be estimated in the stereoscope.

RADIOGRAPHY IN THE EXAMINATION OF THE SELLA TURCICA.

In the radiography of the sella turcica the radiographic base line is used; it will be seen from a reference to the description of the parts in relation to it that the line runs along the base of the sphenoidal sinus. The point of intersection of the perpendicular at the mid-point of the line is in relation to the glenoid fossa and the condyle of the lower jaw. The sella turcica lies between this perpendicular line and that at the one-third distance of the base line, rather nearer the latter. The tube therefore requires to be centered about $\frac{1}{2}$ in. above the base line and just a little behind the perpendicular line at the one-third distance, or if the condyle of the lower jaw be taken as the landmark, and it is a very convenient landmark to use, the tube should be centered 1 in. in front of the condyle and $\frac{1}{2}$ in. above it. The technique can be simplified if a screen method is employed, and it is for this purpose that the apparatus now described has been designed. The position of the head is most important. The patient lies upon the couch and his head is fitted into the apparatus. A small fluorescent screen protected by lead glass enables the operator to centre rapidly upon the sella; in addition, a rapid plate-changing cassette is incorporated in the apparatus for stereoscopic work. The apparatus can also be used with the patient in the upright position, and a technique similar to that described by Scott can be followed.

DESCRIPTION OF APPARATUS FOR RADIOGRAPHY OF THE SELLA TURCICA.

A Coolidge tube with a sharp focus and of the radiator type capable of passing 30 milliamperes is preferred. This is enclosed in a ray-proof box, in the front of which a small round or square aperture is made, just sufficiently large to allow of the illumination of a half-plate at a distance of two feet from the centre of the anticathode to the surface of the plate; the object of the small aperture is to ensure sharpness and cut down the secondary rays as much as possible. Attached to the upper aspect of the tube box is a horizontal arm extending out from the box to a distance of over two feet. On this arm are two smaller arms at right angles to it, and so arranged that they move readily along the horizontal axis, and at the extremity of each a small metal ring is attached. The centre of the ring in each case should be in the line of the

central ray from the tube when the latter is centered accurately. The arrangement is adapted from the description given by Campion in a paper published in the ARCHIVES in September, 1918.

This is a very accurate and simple arrangement for the centering of the skull in radiography of the various regions, and one for which we are greatly indebted to Mr. Campion. A base piece consisting of wood, or preferably metal, forms the main support of the head-rest. On it are arranged clamps,

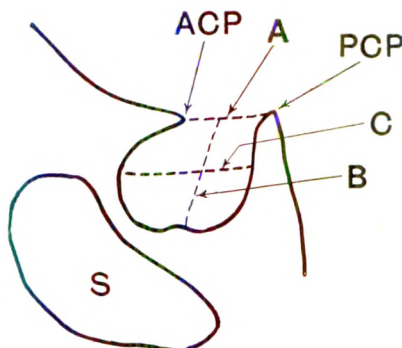


FIG. 3.

and suitable protective apparatus for the accommodation of the patient's head. At the distal end of this base-board a right-angled support is placed; this serves the double purpose of accommodating a screen holder and a plate-changing cassette. The centre of this upright has an aperture just large enough to allow of the exposure of a half-plate, the rest of the front aspect of the board being protected by thick lead. On the posterior aspect of the plate-changing arrangement a small screen is fixed, and the centre of the screen is exactly opposite the centre of the anticathode of the tube. The accuracy of the centering should always be tested before an actual exposure is made. The advantage of screening the skull beforehand is obvious.

THE NORMAL SELLA TURCICA.

The average measurements of the sella turcica must be kept in mind. The outline of the cavity is important; any variation of its contour may be an early indication of disease.

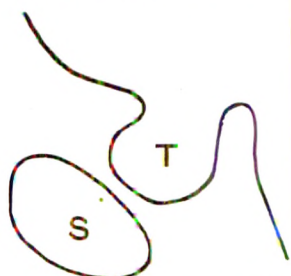


FIG. 4.—Sketch showing the bony relation of the parts, T, Sella turcica. S, Sphenoidal sinus.

The bony landmarks are valuable in the making of measurements; the space between the clinoid processes is not a reliable guide, because of the many normal variations in the size of the clinoid processes, though the distance between the processes may be of great importance in diseased conditions. The depth can be measured by joining up the anterior and the posterior processes by a line, and taking the depth at right angles to the line. The actual size of the cavity can be measured by drawing a line between the two most distant points anteriorly and posteriorly.

The pituitary body, or hypophysis cerebri, formerly called the pituitary gland, from its being erroneously supposed to discharge a secretion of pituita into the nostrils, is a small reddish-grey mass, of a somewhat flattened oval shape, widest in the transverse diameter, and occupying the sella turcica of the sphenoid bone. It has a prolongation of the dura mater, the diaphragma sellæ

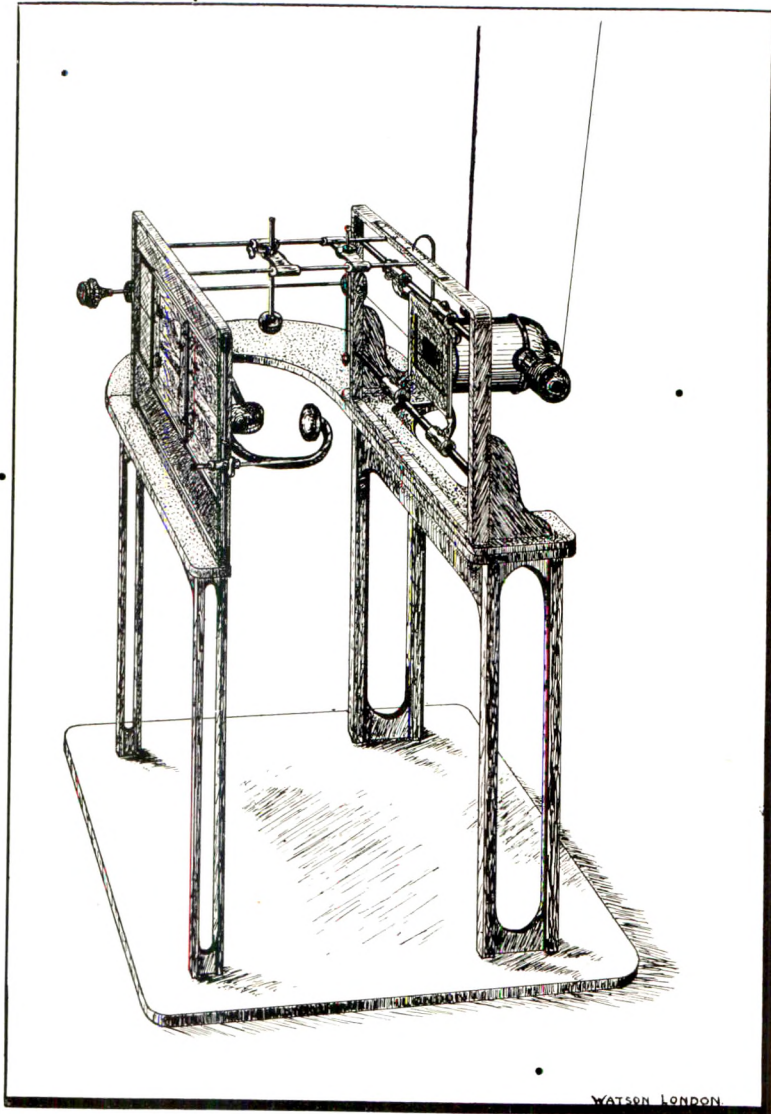


FIG. 5.—Apparatus designed for stereoscopic radiography of the skull.

completely enclosing it, except above, where there is a small aperture for the passage of the infundibulum. It is composed of two lobes, of which the anterior is the larger, and is convex behind, where it embraces the smaller posterior lobe.

From a consideration of the anatomical relations of the pituitary body, it will be seen what important effects may be produced by pressure upon the

adjoining structures, when the pituitary body is the seat of a tumour or other lesion.

From a survey of the anatomical drawings, and more particularly an inspection of the sella and the pituitary body in the dissecting room, it will be seen that a certain amount of moulding of the bony parts occurs from the contour of the two lobes, and in disease this becomes more marked when either lobe enlarges, Fig. 7. The moulding may then be considerable, and it is always a difficult matter to decide when the normal moulding is departed from and the condition becomes pathological. It is also possible in disease for the enlargement to take place in a lateral direction, when there may be at the most only a slight variation in the other dimensions, or none at all.

Another important point in the consideration of the normal appearance of

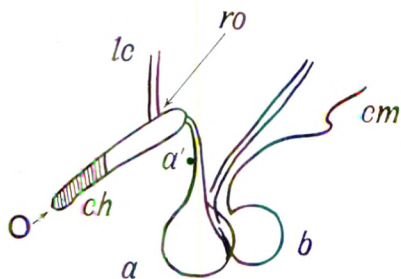


FIG. 6.—Sagittal section of the pituitary body and infundibulum with the adjoining part of the third ventricle (Schwalbe). *a*, Anterior lobe; *a'*, projection from it towards the front of the infundibulum; *b*, posterior lobe, connected by a solid stalk with the infundibulum; *lc*, lamina cinerea; *ro*, recess of the ventricle above the chiasma; *cm*, corpus mamillare; *ch*, section of chiasma.

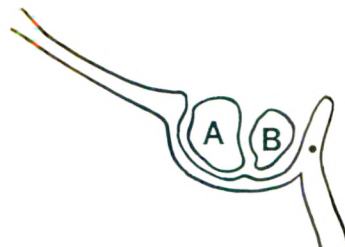


FIG. 7.

the sella turcica is when, from incorrect centering or an inaccurate position of the head, the sella appears to be deformed. On several occasions this has led to an erroneous diagnosis. In all radiography of this region the most absolute accuracy in technique is essential. Air cells, possibly abnormal, have before now, when projected into the sella, led to a diagnosis of disease of the pituitary region when none existed.

Apparent closure of the inlet by enlargement of the clinoid processes has been, at a later examination, found to be due to an inaccurate position of the head; examples are shown in Figs. 12, A, B, C.

It is also important to bear in mind well-known anatomical variations in the size and shape of the clinoid processes. Bridging of the gap is met with, and this may in the radiogram appear to completely cut the sella turcica off from the interior of the skull. Stereoscopic radiograms taken at different angles will be very helpful in clearing up many of these doubtful points.

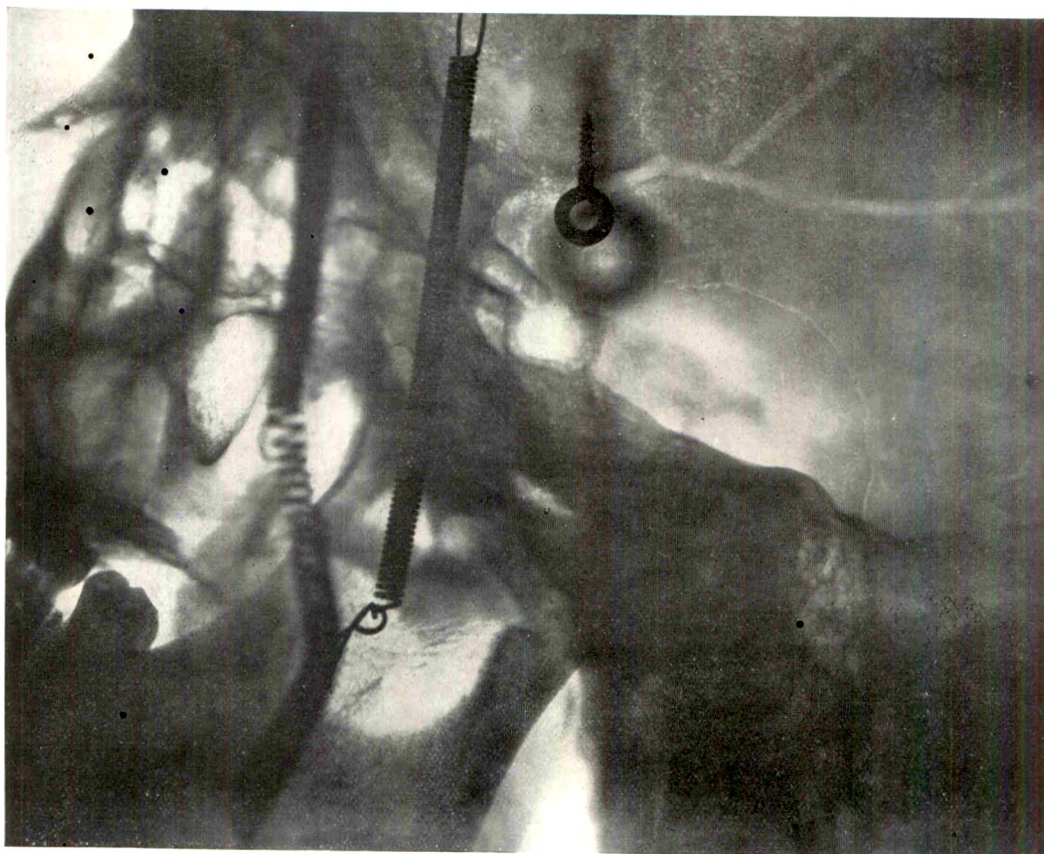


FIG. 8.—Dry skull, showing inaccurate centering.



FIG. 9.—Dry skull, showing accurate centering above the sella turcica. (Campion's method.)

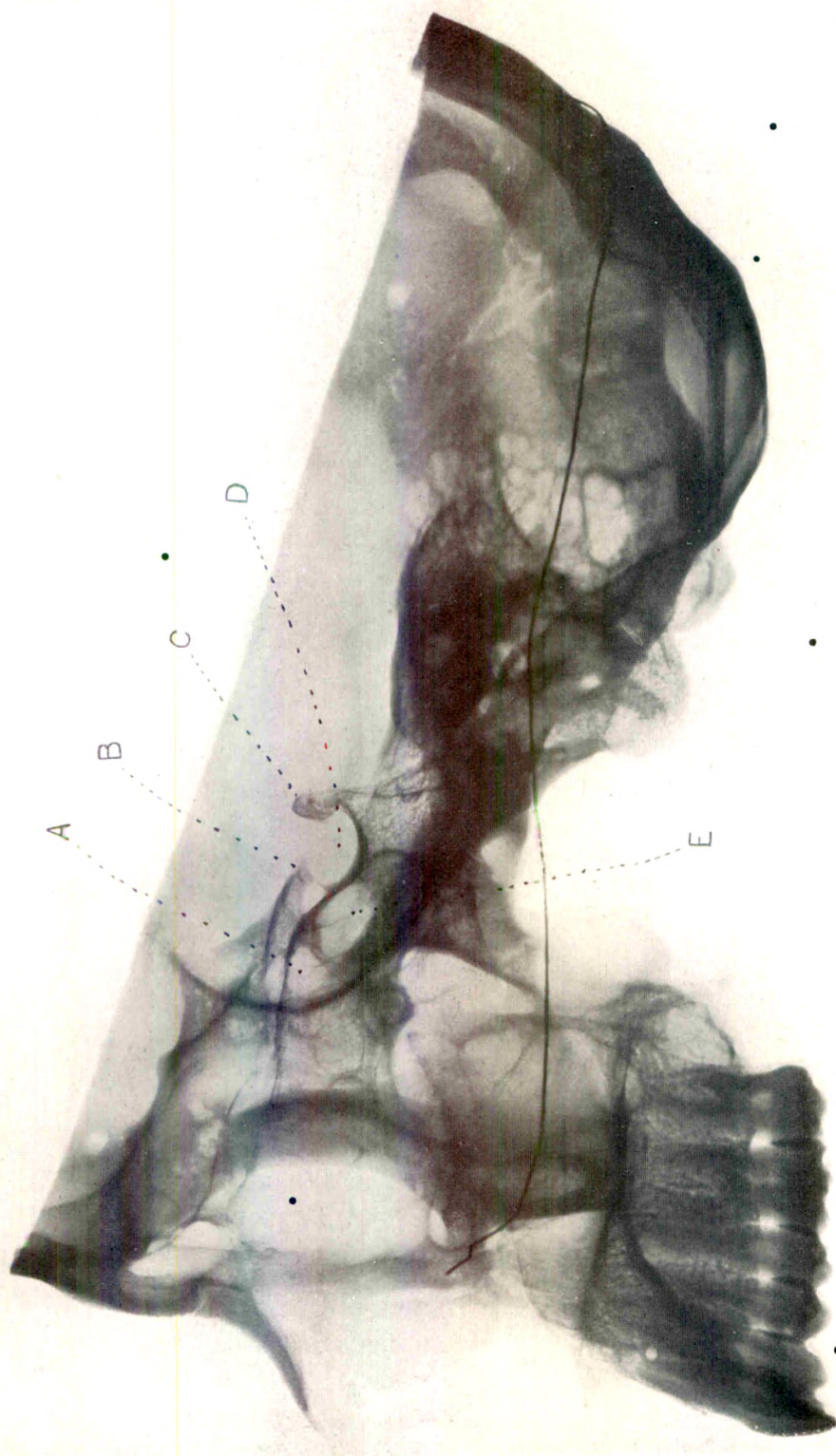


FIG. 10.—Radiogram of a skull.

A. Posterior ethmoidal air cell. B. Anterior clinoid process. C. Posterior clinoid process. D. Pituitary fossa. E. Sphenoidal sinus.

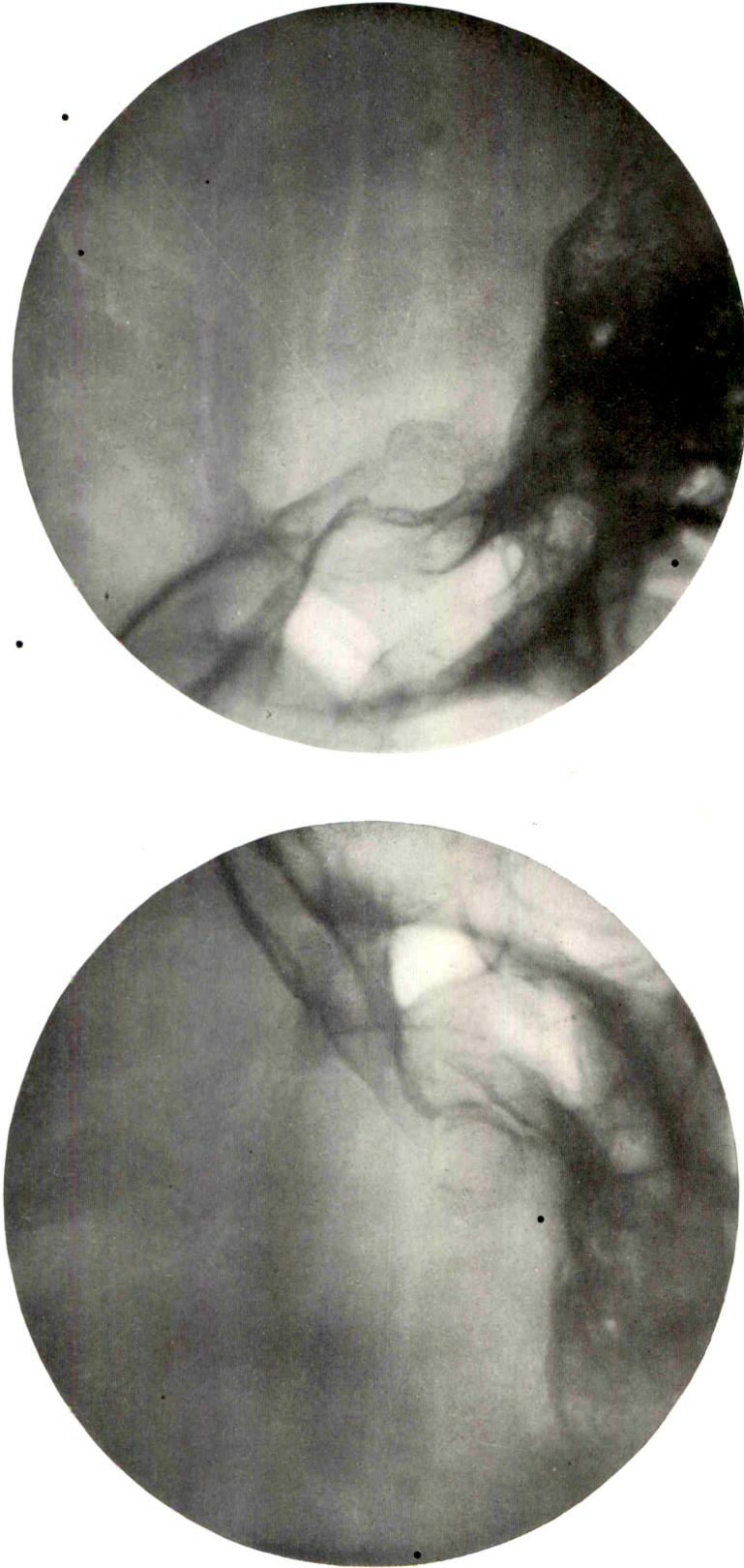


FIG. 11.—Sella turcica in same patient, radiographed from right and left sides of the head.

A. Shows a fairly normal sella turcica.
B. Shows an apparent distortion due to faulty position of the head when the radiograph was taken.

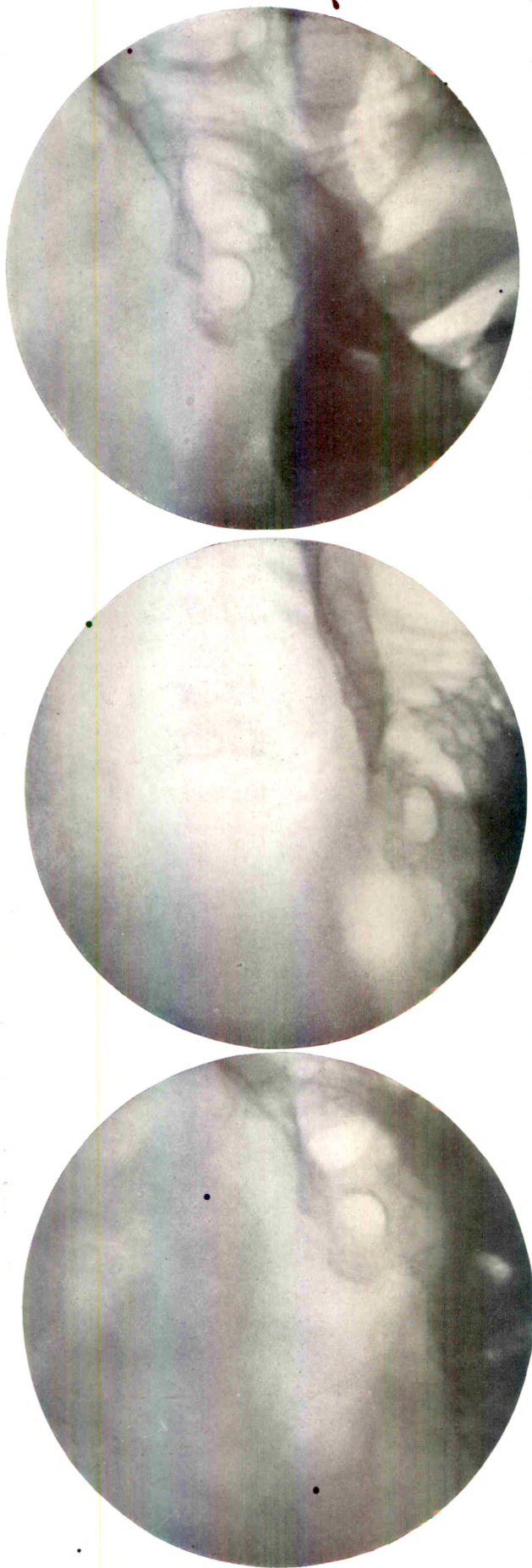


FIG. 12.—Three views of the same sella turcica, showing the effect of correct and incorrect centering of the tube.

- A. Shows the close approximation of the clinoid processes, which in this picture suggested bony ankylosis.
- B. Indicates a narrow opening.
- C. The opening is a little larger. Note the very marked bony development of the clinoid processes.

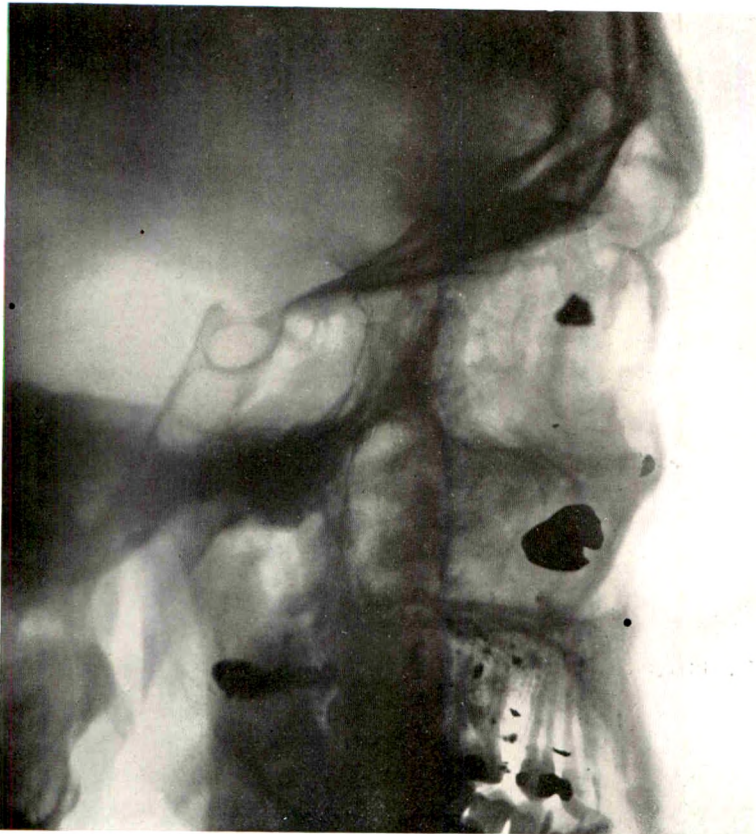


FIG. 13.—Normal sella, from a patient who had a gunshot wound of the face. The good definition of the sella region in this case is probably due to air having entered the cranial cavity by way of the injured sphenoidal sinus.

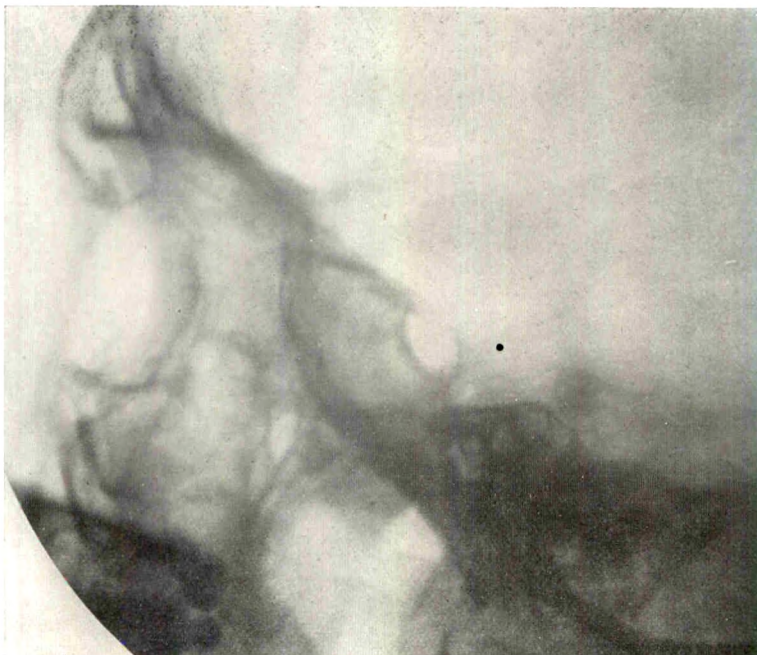


FIG. 14.—Distorted appearance of the sella turcica is probably due to faulty centering of the tube.

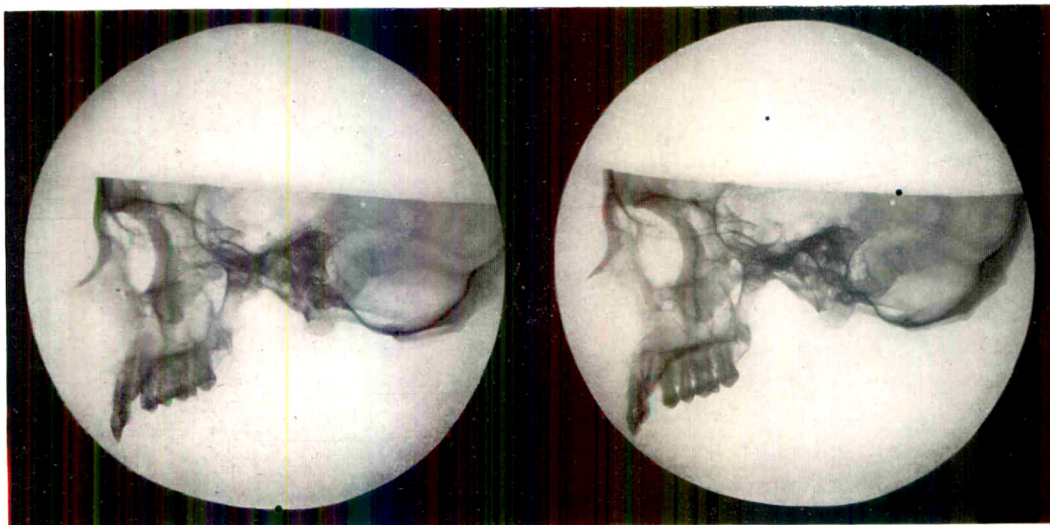


FIG. 15.—Stereoscopic radiograms of dry skull to show the relations of the bony parts.

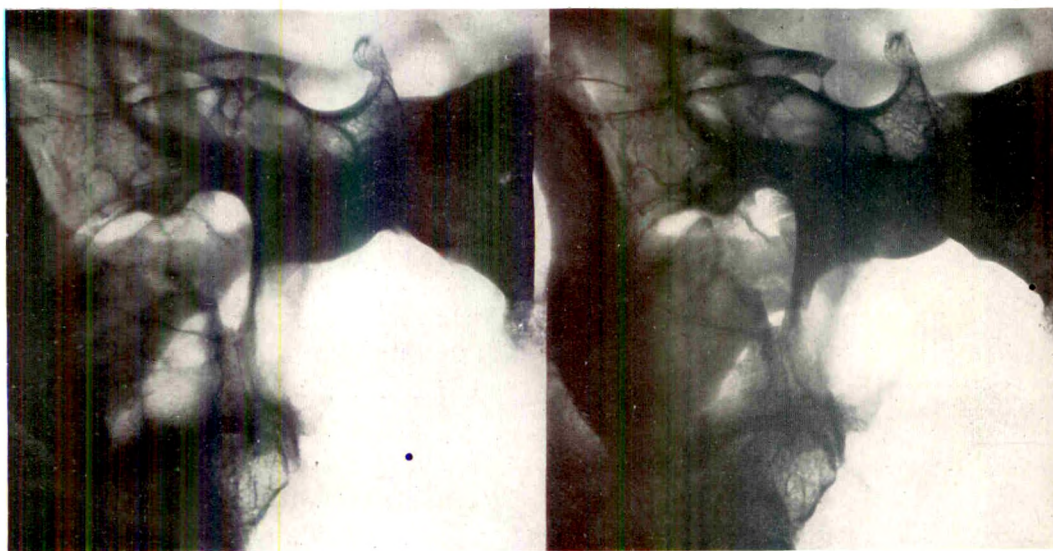


FIG. 16.—Normal sella turcica from the dry skull. Mesial section through the bones. The radiogram shows one anterior clinoid process.

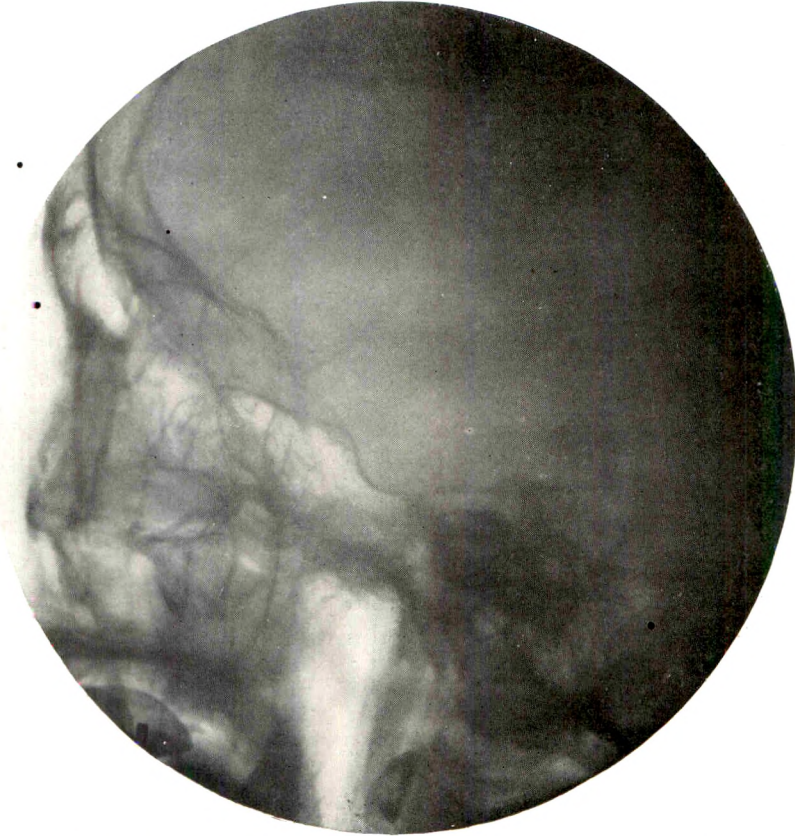


FIG. 17.—A normal sella turcica from a case of sarcoma of the orbit. The tube for this radiogram was centered for the orbit, well in front of the external landmark for the sella. Note the apparent flattening of the sella.

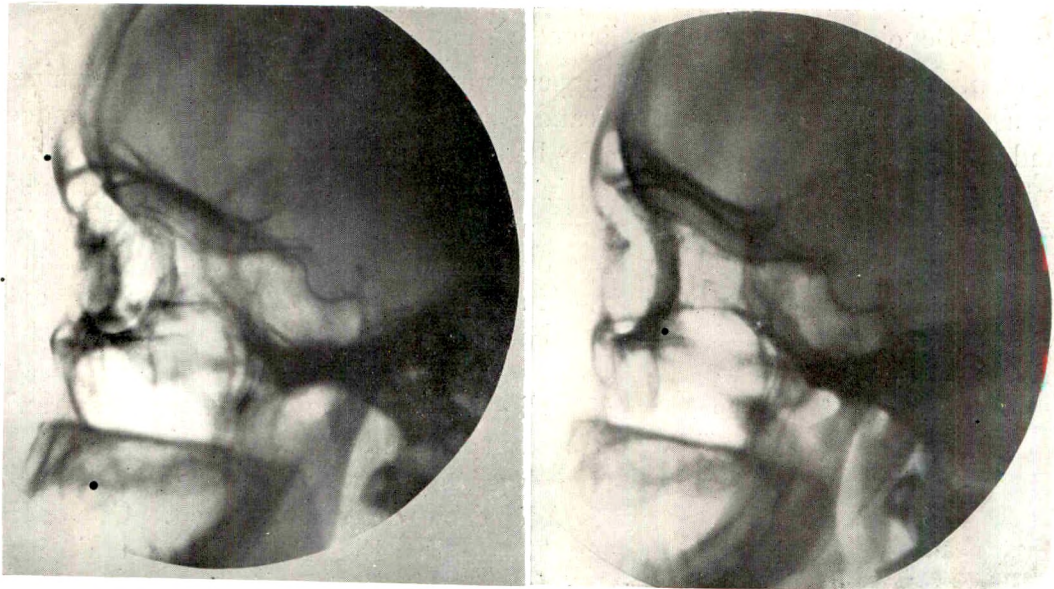


FIG. 18.—Stereoscopic radiograms of a normal sella turcica.

(To be continued.)

A PHOTOGRAPHIC DESENSITISING AGENT IN RADIOGRAPHY.

By A. BRUCE MACLEAN, M.D., Assistant Radiologist, Royal Infirmary, Glasgow.

LUISADA has recently called attention to the use of safranin as a desensitiser in developing X-ray negatives. The use of a desensitising dye stuff, to enable development to be carried out by white light, instead of the usual ruby safe-light, is of recent introduction, and we owe this to Lüppo-Cramer, who, investigating the action of a number of dyes, found the safranin group to have most action. The method of using a desensitiser has for the past three years or so been exploited commercially, and "Desensitol," a solution of safranin, is marketed by the Ilford Company for the use of amateur photographers. Crowther gave the first account in English of the work of Lüppo-Cramer in this connection. Other substances have been worked at, and investigations carried out by Messrs. Lumière and Seyewetz showed that amethyst-violet, giroflé, safranin M.N., creso-safranin, and pheno-naptho-safranin proved to be good desensitisers, while others showed no effect. Picric acid and aurantia were also found to have a good desensitising effect. One of the drawbacks to the use of safranin is the staining of the gelatine of the plate, and also the fingers. To overcome this König has introduced "Pinakryptol," the formula of which has not been published.

Luisada states that the effects gained by using safranin in X-ray development are as follows :—

1. It allows development and fixation of the plate by white light.
2. Greater relief of the image is produced and therefore better contrast.
3. It prevents totally photographic veiling.
4. Development may be prolonged without ill effect.

Under Head 1 there does not appear any obvious advantage to be gained in using a feeble white light, one candle being the illumination recommended, and this source of light will scarcely be so convenient as the Kodak ceiling reflector light. Veiling of the negative does not appear to cause much trouble when using double-coated films, but under Heads 2 and 4 anything which will increase contrast and produce brighter pictures and will allow of prolonged development is well worthy of investigation. A number of experiments were carried out, and it is thought that the results might be of interest to other workers.

A number of exposures were made to determine the effect of safranin (pheno-safranin), and, as it was necessary to conduct the experiments under proper control, the method adopted was as follows: A pair of films were inserted in a film holder and exposed for each part radiographed. One of the pair was developed by the usual routine, in the Kodak developing tank, with the standard Kodak formula, for the usual time of five minutes at 65 degrees Fahrenheit. The other film of the pair was treated to a bath of safranin, well rinsed and then inserted in the developing tank. The dye used was Grüber's

safranin (soluble) and the preliminary bath was made up of this dye in a solution of approximately 1:5000 (1.8 gm. to 2 gallons of water). It was very quickly found that development was very decidedly altered from the normal, and that the dye exercised a distinct retarding effect on development, which had to be prolonged well beyond the standard Kodak time.

The following is from the notes made from each pair of films:—

PAIR 1.—A shoulder joint. Kodak ordinary films. Both films developed for five minutes by safelight. It was found that the safranin film was thin and under-developed looking, while the quality of the other was good, although perhaps slightly under-exposed.

PAIR 2.—A wrist. Ordinary films. The safranin film was developed for six minutes. There is perhaps nothing easier to radiograph than the carpus, and good pictures are the rule rather than the exception. This picture was very good and gave excellent relief. The two films were of almost equal density, and only by close comparison could any difference in quality be detected. The safranin film was slightly brighter, and it was noticed that in the unstained film the whites (the clear parts) were slightly fogged, but this could only be detected by close comparison. Any difference, however, was so slight as to be negligible in practice.

PAIR 3.—Elbow joint. Super-speed films. Here the dyed film was developed for six and a half minutes. The densities of the two films were approximately the same, but if anything the dyed film was slightly brighter.

The above films were made with a Coolidge radiator tube, and at this stage it was thought that it would be better to make films of poor quality, using a hard tube, in order to see if it were possible to obtain contrast, which is not obtainable in the usual course. A "Leviathan" tube was next tried, and as this tube had not been used for six months it was thought that the long rest would have rendered it "hard." This did not prove to be the case, the tube had the same characteristics as when laid aside. The next two pairs were made with this tube.

PAIR 4.—Knee. Ordinary films. The film developed in the usual way was of good quality. The dyed film was developed 25 per cent. longer than normal, by diffused white light, obtained from a viewing box about ten feet distant from the tanks. Although the film was examined from time to time by this light there was no trace of fog, and the quality was slightly better than the other film.

PAIR 5.—At this point the question arose as to whether wetting alone might have some retarding effect on a film and alter slightly the time of development. One film of this pair was soaked in clean water for two minutes to saturate the gelatine, and then developed. The other film was placed directly in the tank. The two were developed for exactly the same time. There was no difference whatever in the two negatives. This experiment also settled the question as to whether the film nearer the tube might be more exposed than the other, and might account for the slight difference in quality of the previous pairs.

It was hoped that the above two pairs would be of poor quality, but this did not prove to be the case. Another tube was used, one fitted with a Bauer air valve. No name could be too bad for this tube, and I think it would be the despair of any radiologist. Although it runs soft, 30 ma. 4'' gap, it only emits hard rays, and very few even of these. This tube was selected, secure in the knowledge that the results would be bad. With the exception of the wrist, where of course fairly good negatives can be secured whatever the state of the tube, the results were poor and the negatives useless for any diagnostic purpose.

PAIR 6.—A wrist. There was little to choose between the two films.

PAIR 7.—This was a lumbar spine. Both pictures were very poor, the negatives being very thin. Although the safranin film was developed 50 per cent. longer than the other, it was thinner. The other film showed some fog, which seemed to supply some general density to the negative. The non-dyed film was developed for seven minutes.

PAIR 8.—Hip. The normal film was fogged by holding it close to the safelight. The safranin film was developed by white light, and development was prolonged for twelve minutes. During development it was fogged, on one side only, by holding it close to the source of white light: before fixation there was a much better image on the unfogged side of the safranin film than on the unfogged side of the normal film. After fixation, however, this was lost altogether.

PAIR 9.—Wrist. The object here was to determine the effect of gross over-exposure. The normal film was developed for three minutes, when it was removed from the developer as it had turned black completely. As usual with films over-exposed and under-developed, the contrast was poor. The safranin film was developed for five minutes, then fixed. This film behaved like a film in the usual routine of working. It appeared fully developed, showed no sign of fog, and even although the development was relatively so much longer than its neighbour, there was no evidence of any tendency for the film to become black all over. The result was a film excellent in every way.

It will be seen from the above that development by a weak white light can be carried out with safety, after the film has had a preliminary immersion in a suitable desensitising agent. With regard to the alteration in quality of the negatives, little difference is to be detected in films correctly exposed and correctly developed. With under-exposure the results appear to be worse with the desensitising method. Where the film is over-exposed the advantage gained is considerable, owing to the marked retarding effect on development, and the method ought to have a future, especially in those cases where over-exposure is fatal to success, as for example in gall bladder work and in kidney work. As far as my experience goes, in this class of work the maximum development is necessary in order to secure all possible detail and contrast, and this can only be obtained by development prolonged beyond the normal time, but this cannot be secured unless the exposure is so calculated as to allow for the additional development. There was little trouble found from staining of the gelatine; most of the dye was removed in washing, leaving only a faint pink tint in the negative.

SUMMARY.

1. Development of films can be carried out by white light, with observation of certain conditions.
2. With correctly exposed negatives, any advantage gained by the method is so slight as to be negligible.
3. With under-exposed negatives, the method is not to be recommended.
4. With over-exposed films, better results are obtainable than by the usual method of development.
5. The dye acts as a very powerful restrainer in development.

REFERENCES.

- Crowther, *British Journal of Photography*, January, 1921, p. 3.
 Lüppo-Cramer, *Photographic Almanac*, 1922, p. 370.
 Lusada (*L'uso della safranina in tecnica radio-fotografica*), *La Radiologia Medica*, X, p. 381.
 König, *Photographic Almanac*, 1923, p. 350.

NOTE ON ELEVATION OF THE DIAPHRAGM AND UNILATERAL PHRENIC PARALYSIS.

By CLARENCE WRIGHT, F.R.C.S.

I HAVE followed Dr. Woodburn Morison's article on the above subject with great interest, and should like to supplement his findings by alluding to four cases of my own, which I think will extend our knowledge of this peculiarity.

1. Claim 14207. T. E. F. Off. No. C. 5213. 7th May, 1921. *History*.—When working down a 17 ft. deep trench received a pail of wet mortar on his neck. The edge of the bucket caught him on the left side of the neck at the level of the fourth cervical vertebrae. In this case the breathing was laboured and suggestive of pneumonia, and continued so until the date of his X-ray examination by me (7th May, 1921). It was then noticed that the left leaf of the diaphragm had taken on the *typus inversus*, i.e., rising with inspiration and falling with expiration. Treatment was mainly directed to the local injury, and all symptoms, both subjective and radioscopic, cleared up in five months time.

2. Claim 16103. R. A. W. Off. No. C. 7325. 19th December, 1921. *History*.—The patient was knocked off a scaffolding by a key-stone, which struck him on the right side of the neck. In this case also the breathing was very laboured and suggestive of pneumonia, but that there was a marked brachycardia and weakness of the pulse on the right side as well. X-ray examination showed elevation of the diaphragm on the right side without visible movement upon respiration. Treatment was directed to the local cause. Result: he was free of all symptoms and able to resume work after seven months.

3. Miss L. G.—A rheumatic subject with a badly damaged heart, developed præcordial oppression and dyspnoea after an acute attack of influenza. On screen examination it was noticed that whereas the diaphragm moved freely and naturally in the absence of any original symptoms, yet on the advent of a paroxysm and throughout its continuance there was much diaphragmatic elevation on both sides, but without movement during respiration, which was purely of the costal type. The heart beats were extremely hurried and missed one beat in seven. Some five hours after this screen examination I was called in to see her die of "heart-hunger." At the autopsy the coronary arteries were found blocked up and occluded by blood clot.

4. Mr. W. E. S.—A man who, except for a transient catarrh of the stomach and bowels, a somewhat increased blood pressure, and some vague pains in the lower part of the abdomen, presented no clue to the cause of his recurring attacks of dyspnoea and heart-anguish, was submitted to X-ray examination. The diaphragm was found to be elevated, with very little play upon the left side. A consideration of Miss L. G.'s case (No. 3) suggested that I had to deal with a case of heart-block. I prescribed accordingly. Some five weeks later I was told by his relatives that he had died suddenly after a heart-attack, and that at the autopsy the coronary arteries were found to be highly calcareous and blocked with a clot.

Remarks.—Case 2 shows us how a phrenic injury can have a reflected effect upon the heart, whilst Cases 3 and 4 show us how this influence is reciprocated; the heart-innervation in its turn affects the phrenic nerve and the diaphragm.

RÖNTGEN SOCIETY, SESSION 1923-1924.

President, SIR OLIVER LODGE, LL.D., D.Sc.,
F.R.S.

April 1st, 1924; May 6th, 1924; June 3rd, 1924.

A General Meeting will be held on Tuesday, December 4th, 1923, at 8.15 p.m., in the British Institute of Radiology, 32, Welbeck Street, London, W. Paper on "Modern Radiological Technique," by Dr. L. G. Heilbron, of Amsterdam.

Refreshments will be served after the meetings in the Common Room of the Institution.

E. A. OWEN, M.A., D.Sc.,
National Physical Laboratory,
Teddington, Middlesex.

RUSSELL J. REYNOLDS, M.B., B.S.,
140, Harley Street, W. 1.

Hon. Secretaries.

The meetings of the Röntgen Society will be held in the "Institution of Electrical Engineers," Savoy Place, Victoria Embankment, London, W.C. 2, on the following Tuesday evenings, at 8.15 p.m.: November 6th, 1923; December 4th, 1923; January 8th, 1924; February 5th, 1924; March 4th, 1924;

Telegraphic Address of the Institution of Electrical Engineers: Voltampere, Phone, London. Telephone Number: Gerrard 764. Nearest Tube Stations: Charing Cross, Temple.

CURRENT LITERATURE.

Veils in the Right Hypochondrium and their Differentiation from other Organic Lesions and Spasm.—L. G. COLE (*Am. Jour. of Roent.*, March, 1922, Vol. IX, No. 3, pp. 137-148).—Deals with delicate membranous or cob-web adhesions between gall bladder and duodenum, pylorus, or hepatic flexure of the colon, which may be either congenital or acquired, but are associated with an otherwise normal gall bladder. The symptoms are those of pain and burning, especially after meals and when standing upright, and the roentgenological appearance may simulate post-pyloric ulceration or inflammatory gall bladder adhesions to the duodenum. The article contains careful anatomical drawings explanatory of the skiagrams, and the author calls attention to the possibility that the adhesions may be missed at operation by a surgeon unfamiliar with the condition described.

Minimum Erythema Dose with Diagnostic Voltages.—A. W. ERSKINE (*Ibid.*, pp. 148-149).—Calls attention to the fact that so-called minimum erythema doses may be given with considerable variations in dosage.

Possibilities of Roentgen-Ray Treatment in Cancer of the Pancreas.—G. E. RICHARDS.

(*Ibid.*, pp. 150-152).—Describes the result of treating three cases of inoperable carcinoma of the pancreas by deep therapy, with marked improvement in two cases, the observations extending over twelve months.

The Relation of Temperature Changes to Roentgen-Ray Skin Reactions.—C. L. MARTIN and G. T. CALDWELL (*Ibid.*, pp. 152-161).—Discusses the effect of moderate variations in temperature in accentuating the results of radiation, more especially the increased tendency to ulceration due to adhesive plaster or other pressure covering to the skin, whether due to increase of heat or not. In the subsequent discussion of this paper stress was laid on the aggravated reaction produced by the use of such applications as iodine, mercury preparations, salicylic acid, nitrate of silver, balsam of Peru, and particularly scarlet red, which last will invariably cause a third degree radio-dermatitis with a dose calculated to give otherwise a mild erythema. It was further suggested that the erythema which occasionally appears in treated areas within a few hours of the dose, and disappears within twenty-four hours, was due to static electricity, and could be overcome by grounding the lead.

The Value of Interstitial Radiation.—D. QUICK (*Ibid.*, pp. 161-166).—Deals with buried tubes of radium emanation.

Roentgen Rays of Short Wave-Lengths and their Measurement.—W. DUANE (*Ibid.*, pp. 166-171).—Valuable paper dealing with the quality of radiation and effective wave-length transmitted by 12 mm. aluminium and 1 mm. copper respectively under certain variations of initial wave-length. Describes the method of measuring and gives curves for calculation of equivalent thicknesses of aluminium and copper with any given wave-length from .4 to .08 Angström units.

The Auto-Electronic Discharge and its Application to the Construction of a New Form of X-Ray Tube.—J. E. LILIENFELD (*Ibid.*, pp. 172-179).—Describes an experimental X-ray tube, which may prove to be of great importance, in which the necessary electrons are liberated on an unheated and cold cathode in the absence of any kind of ionisation, either the ionisation of residual gases (gas-filled tubes), or an ionisation through a hot spark discharge, *i.e.*, electric arc (thermionic tube).

Stereofluoroscopy.—J. D. MORGAN (*Ibid.*, pp. 180-183).—Two X-ray tubes with targets placed several inches apart are alternately excited, and the screen is viewed through a shutter placed in front of each eye vibrating synchronously with the lighting of the tubes.

New Technique for the Vertical Examination of the Sphenoids and Ethmoids, with Demonstration of Special Sphenoid Film Holder.—G. E. PFAHLER (*Ibid.*, pp. 183-185).—The tube is placed nearly vertically above the head, using a long cylindrical diaphragm, with a special film holder in the mouth reaching back to the pharynx.

Dental Roentgenography in the Light of Clinical and Pathological Findings.—A. S. WOLFE (*Ibid.*, pp. 186-193).

Experiences with the Potter-Bucky Diaphragm.—G. FIELDS (*Proc. Roy. Soc. Med.*, February, 1922, Vol. XV, No. 4, Section of Electrotherapeutics, pp. 7-10).

Observations upon the Action of Radium and X Rays on the Mononuclear Leucocytes of the Blood of Rats.—J. C. MOTTRAM (*Ibid.*, Section of Pathology, pp. 1-2).—Suggests that

the temporary diminution in circulating leucocytes after exposure to X rays is not general but is due to especial sensitiveness of the small mononuclears.

Radiological Anatomy of the Lungs.—J. GARCIN (*Jour. de Rad. et d'Élect.*, Vol. VI, No. 3, March, 1922, pp. 110-121).—Topographical study, illustrated with skiagrams showing injected bronchial and vascular "trees," etc.

The Radiotherapy of Malignant Tumours.—PERTHES (*Ibid.*, pp. 122-130).—Report presented in 1921 to the Congress of the German Society of Surgery by Professor Perthes of Tübingen.

Photographs of Organs by Radium Emanation or "Radiumgraphy."—A. KOTZAREFF (*Ibid.*, pp. 131-133).

Two Cases of Recurrent Tumours in the Axilla after Removal of an Epithelioma of the Breast.—A. GUNSETT, D. SICHEL, and J. HOFFEL (*Arch. d'Elect. Med.*, Vol. XXXII, No. 474, March, 1922, pp. 65-74).—Describes the technique adopted by the authors. Incidentally criticises claims to a definite carcinoma or sarcoma dose, and calls attention to the varying sensitiveness to X-ray erythema of various parts of the body (*e.g.*, a marked radio-dermatitis in the sacral region with a dose which did not even provoke an erythema on the nape of the neck).

Treatment of Hypertrophy of the Tonsils by Diathermic Coagulation.—H. BORDIER (*Ibid.*, pp. 75-77).—The author operates superficially only and without anæsthetic.

A New Method of Radiotherapy.—T. NOGIER (*Ibid.*, pp. 78-81).—Describes a "chair" in which the patient sits for radiation of the anal, perineal, or vulvar regions.

Considerations upon the Present Conditions of Radiotherapy.—M. PONZIO (*Radio-logia Medica*, Vol. IX, No. 3, March, 1922, pp. 81-90).

Radiotherapy in Typhoid Fever.—E. MILANI (*Ibid.*, pp. 90-107).—Considerations of the hæmatology of the disease, and of the modifications due to vaccines, etc., followed by the discussion of the action of X rays in exciting cellular response in malaria, etc., and in modifying the cellular contents of the blood,

then more especially the effect of X rays in typhoid fever upon the leucocytes, upon the temperature curve, and upon the general symptoms. Particulars of eight cases.

Radiological Appearance of the Sphenoparietal Sinus (BRESCHET) and its Anatomical, Clinical, and Radiological Importance.—G. SIGHINOLFI (*Ibid.*, pp. 107-112).—Possible enlargement and radiographic detection, with especial reference to increased intra-cranial pressure, more especially as a result of tumours, and the increased dangers of serious hæmorrhage during surgical operation on the skull.

Contribution on the Radiological Anatomy of the Thorax.—S. KREUZFUCHS and G. CARMELICH (*Ibid.*, pp. 113-118).

Raynaud's Disease and the Pituitary Body.—N. NICOLIS (*Ibid.*, pp. 118-120).—Describes a case of Raynaud's disease associated with enlargement of the sella turcica. The bones of the hands showed no radiological changes, and the radial and ulnar arteries showed no evidence of calcification.

X-Ray Evidence of Abdominal Small Intestinal States Embodying an Hypothesis of the Transmission of Gastro-Intestinal Tension.—R. W. MILLS (*Am. Jour. of Roent.*, April, 1922, Vol. IX, No. 4, pp. 199-225).—Valuable and suggestive paper, with 62 illustrations, showing the relation of the contents of the small intestine to varying habitus, appearance in secondary carcinoma, chronic peritonitis, stasis secondary to lesions of the large intestine, such as carcinoma, constipation, incompetence of the ileocaecal valve and recto-sigmoid region, etc. Examination of 6,000 cases.

A Conception of Chest X-Ray Densities Based on a Study of Granite Dust Inhalation.—D. C. JARVIS (*Ibid.*, pp. 226-234).—Discusses various stages of development of lung densities due to granite dust inhalation simulating most forms of chest disease, and classified with reference to the hilum and its glands, various forms of density, "peripheral haze," and pleural lymph stasis.

Roentgen-Ray Technique for the Demonstration of Small Pneumothorax.—J. C. THOMPSON and N. BARLOW (*Ibid.*, pp. 235-240).—Recommends stereoscopic skiagrams,

with different exposures, one plate being darker than the other, the dark plate predominating in the picture and giving penetration and contrast, the light plate giving the detail. Describes the technique and discusses interpretation.

The Value of Roentgentherapy in Dermatology.—G. M. MACKEE and G. C. ANDREWS (*Ibid.*, pp. 240-246).—Gives a comprehensive list of over 80 diseases of the skin which are stated to be amenable to X-ray and radium treatment, with brief notes on some of them.

The Roentgen Treatment of Diseases of the Skin.—H. H. HAZEN (*Ibid.*, pp. 247-254).—A much shorter list, with notes as to results and giving the technique employed in each case.

Superficial Malignancies.—C. F. BOWEN (*Ibid.*, pp. 254-259).—The author states that every case of superficial cancer can be cured if seen whilst it is still a localised disease, and describes the treatment as follows: All the growth projecting above the normal skin is destroyed by electric coagulation, after injecting novocaine with a little adrenalin. The burnt tissue is carefully curetted away and the base of the ulcer thoroughly treated with the electric current. The Roentgen rays are then used to destroy any cells which were lying deeper in the tissues. At least 50 ma. minutes of unfiltered rays are used over an area a little larger than the ulcer. Of late the author has acted on the suggestion that heat makes cancer cells more susceptible to X-ray treatment, and gives the massive dose of X rays first and then immediately follows with heat coagulation. He states that the majority of his cases heal in one month without repetition, but does not mention the subsequent history.

Peristalsis of the Colon.—P. M. HICKÉY (*Ibid.*, pp. 260-261).—Describes the movements observed in the colon whilst watching the emptying of a barium enema, and how it can be used to differentiate between spastic and organic constrictions.

Instrumental Simplification for the Measure of the Chronaxie.—H. GUILLEMINOT (*Jour. de Rad. et d'Élect.*, Vol. VI, No. 4, April, 1922, pp. 157-161).—Describes a simple method of measuring the chronaxie directly.

Abdominal and Thyroid Galvanisation in the Treatment of Basedow's Disease.—M.

MÉNARD and F. FOUBERT (*Ibid.*, pp. 162-170).—The author discusses the relative advantages and disadvantages of treatment of Graves' disease, by galvanisation and radiotherapy respectively, considers that the thyroid is not the only endocrine gland affected, and advocates galvanic treatment to both thyroid and abdomen. Two long plates, 35 cm. by 15 cm., connected with the positive pole are placed on each side of the whole length of the spine, two other plates connected with the negative pole are placed on the thyroid and on the abdomen, that on the thyroid measuring 150 sq. cm. and that on the abdomen 35 cm. by 25 cm. The total current varies from 65 to 250 ma., according to the variable tolerance of the patient, and the time of application is twenty to thirty minutes, repeated thrice weekly. Discussion of eight cases. (Short summary in ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY, No. 267, October, 1922, pp. 143-144.)

Theoretical and Practical Considerations upon the Present Employment of Deep Therapy.—NADAUD (*Ibid.*, pp. 171-180).—Discusses the various physical factors concerned with mathematical formulæ, calls attention to the errors in calculations based on measurements made without reference to the actual body irradiated, especially with very hard rays, and insists that the evaluation of intensities at different depths must be measured direct and not deduced by calculation.

Sarcoma of the Tonsil Treated by Deep Radiotherapy. Complete Disappearance.—G. CANUYT and A. GUNSETT (*Ibid.*, pp. 181-183).

Stomach in the Left Thorax. Diaphragmatic Hernia.—V. NALLI and J. DE BEAUJEU (*Ibid.*, pp. 184-186).

Principles of Radiological Diagnosis of Duodenal Ulcers.—KERGOHEN (*Arch. d'Elect. Méd.*, Vol. XXXII, No. 475, April, 1922, pp. 97-119).—Discusses technique, advocating radiography in the upright position, with slight compression of the patient against the plate. Describes, and discusses with diagrams, various forms of duodenal ulcer.

Sub-acute and Chronic Arthritis of Single Joints as Sole Manifestations of Syphilitic Infection.—F. CATTANEO (*Radiologia Medica*, Vol. IX, No. 4, April, 1922, pp. 137-153).—Discusses the differential radiological and

clinical diagnosis, more especially between syphilis and tubercle, and gives details of eleven cases. Good illustrative plate.

Bases and Principles of Deep Radiotherapy and its Present Application in German Clinics.—G. PAROLI (*Ibid.*, pp. 153-172).—The first part of data gathered by the author from a visit to German clinics.

Histological Pictures Representing the Cure of Uterine Baso-cellular Epithelioma.—F. DAELS (*Proc. Roy. Soc. Med.*, April, 1922, Vol. XV, No. 6, Section of Electrotherapeutics, pp. 11-13).—(Appeared in the ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY, No. 275, June, 1923, pp. 1-17, with 22 photo-micrographs.)

The Radiation of the True Pelvis with the Help of Drainage Tubes.—F. DAELS (*Ibid.*, pp. 14-20).—(Appeared in the ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY, No. 271, February, 1923, pp. 257-268).

Papilloma of Cheek and Palate Treated by Diathermic Cauterisation.—W. HOWARTH (*Ibid.*, Section of Laryngology, p. 25).

Sarcoma of Lower Pharynx Treated by X-ray. Disappearance of the Growth.—D. MCKENZIE (*Ibid.*, p. 28).

Further Attempts at the Experimental Production of Carcinoma by Means of Radium.—W. S. LAZARUS-BARLOW (*Ibid.*, Section of Pathology, pp. 7-12).

The Structure and Dimensions of Molecules.—A. O. RANKINE (*Jour. of Roent. Soc.*, April, 1922, Vol. XVIII, No. 71, pp. 56-61).

A Precision X-Ray Apparatus.—M. MORRISON (*Ibid.*, pp. 62-68).

A Boiling Water Tube for Deep Therapy.—C. ANDREWS (*Ibid.*, pp. 69-71).

How to Prepare for 200,000 Volts in Radiology.—A. E. DEAN (*Ibid.*, pp. 72-76).

The Efficiency of the Bucky Diaphragm Principle.—R. B. WILSEY (*Ibid.*, pp. 77-89).—Experimental investigation of various widths and depths of slits.

Diagnostic Pneumothorax.—R. STAHL (*Fortschritte a. d. Geb. d. Roentgenstrahlen*, Vol. XXIX, Part 2, April 22nd, 1922, pp. 169-172).—The use of artificial pneumothorax for diagnosis, by which the author has diagnosed a localised abscess, and a tumour of the lung masked by pleural effusion. Six skiagrams.

PUBLICATIONS RECEIVED.

Books.

Les Ulcères de l'Estomac et du Duodenum. By ED. ENRIQUEZ and GASTON-DURAND. (Masson et Cie, Paris.)

X Rays: Their Origin, Dosage, and Practical Application. By W. E. SCHALL, B.Sc. (Wright and Sons, Ltd., Bristol, 5s.)

High-Frequency Practice. By B. B. GROVER, M.D. (Chapman and Hall, London, 21s. net.)

La Chronaxie chez l'Homme. By Dr. GEORGES BOURGUIGNON. (Masson, Paris.)

Les Processus de Désintégration Nerveuse. By Dr. IVAN BERTRAND. (Masson, Paris.)

Chronic Intestinal Stasis. By A. C. JORDAN, C.B.E., M.D. (Oxford Med. Pub., 25s. net.)

Journals.

Acta Radiologica, Nos. 8-9, 1923.

Archives d'Electricité Médicale et de Physiothérapie, October, 1923.

British Journal of Dermatology and Syphilis, November, 1923.

British Journal of Surgery, October, 1923.

Bulletin of the Johns Hopkins Hospital, October, November, 1923.

Bulletin et Memoires de la Société de Radiologie Médicale de France, October, 1923.

Bulletin Officiel de la Société Française d'Electrothérapie et de Radiologie, July, 1923.

La Chirurgia Degli Organi di Movimento, October, 1923.

Kongresszentralblatt für die Gesamte Innere Medizin und ihre Grenzgebiete, October 15th, 22nd, 29th; November 5th, 1923.

Journals—continued.

International Journal of Orthodontia, Oral Surgery and Radiography, October, 1923.

Journal, October 13th, 1923.

Journal of Laryngology and Otology, November, 1923.

Journal de Médecine de Bordeaux, October 10th, 25th; November 10th, 1923.

Journal de Médecine de Lyon, October 20th; November 5th, 1923.

Journal de Radiologie et d'Electrologie, October, 1923.

Journal of Radiology, October, 1923.

Medical Journal of Australia, September 8th, 15th, 22nd, 29th; October 6th, 13th, 1923.

Medical Science, November, 1923.

New York Medical Journal, October 17th; November 7th, 1923.

New York State Journal of Medicine, October, 1923.

Norsk Magazin for Lægevidenskaben, November, 1923.

Il Policlinico, October 15th; November 1st, 1923.

Quarterly Journal of Medicine, October, 1923.

La Revue de Stomatologie, October, 1923.

Surgery, Gynecology, and Obstetrics, November, 1923.

Ugeskrift for Læger, October 25th; November 1st, 8th, 1923.

Urologic and Cutaneous Review, October, 1923.

NOTICES.

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A list of collaborators at home and abroad is being prepared. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

ELECTRICAL ENERGY AS A CURATIVE AGENT.

Presidential Address, by W. J. TURRELL, M.A., M.D.

Royal Society of Medicine, Electrotherapeutic Section, October 19th, 1923.

LADIES AND GENTLEMEN,—I should like first of all to take advantage of the opportunity afforded me by a presidential address by returning my most sincere thanks to the members of the section for electing me as their president for the ensuing session; it is an honour that I most thoroughly appreciate and a responsibility of which I am fully conscious.

I would wish, moreover, to take this opportunity of expressing my great indebtedness to this section in the past. In a rapidly-developing speciality, such as ours, membership of a Society where we can meet to hear and discuss the views and ideas of our fellow-workers is absolutely indispensable for the advancement of knowledge and for our mutual advantage. To country members, after a hard day's work, it requires, as I know from personal experience, a certain amount of energy and resolution to journey to London, take part in a discussion, and arrive home about 2 a.m.; and to those living further away the sacrifice of time is proportionately greater.

But I am convinced that country members, however distant their homes may be, are more than repaid for any trouble they may take or any sacrifice

they may make by the many advantages they derive by the friendships which they establish with their fellow-workers, and by being brought into closer contact with modern views and into personal touch with the most recent work. In fact, I think that it may be laid down as a general rule that the further removed from London a member may reside, the more essential it is in his own interests that he should be regular in his attendance at our meetings. I should very much like to see a considerable increase in our country membership, and more representatives from a distance taking part in our discussions; the section as a whole would undoubtedly benefit thereby, but not to the same extent, perhaps, as the members themselves.

It is now about twenty-two years since the formation of this Society; at its birth it had a separate existence as "The British Electrotherapeutic Society," but at a very early age it entered into a polygamous union with other medical societies to form the "Royal Society of Medicine," a Society of which we are all proud to form a part, and with which I am convinced it is a special advantage for the science of electrotherapy to be connected, dealing as our science does with so many branches of the healing art.

I think that I shall make the best use of this opportunity by making my address take the form of a general survey of the present position of electrotherapy, that is to say, a brief consideration of the steps by which we have arrived at our present position, where we stand, and whither we are trending.

A study of the history of electrotherapy shows us that the earliest forms of electrical treatment took the form of the administration of electrical shocks, and this has largely proved an *hereditas damnosa*, for many patients to this day invariably and timorously associate all forms of electrical treatment with the administration of shocks.

It was by an electrical shock from a torpedo fish that Anthero, a freedman living in the reign of the Emperor Tiberius, was cured of gout about the year one. It was by the shock from an early form of static machine that Kratzenstein, in 1744, cured an apparently functional contraction of the thumb. It is interesting to note that even in the earliest times the application of electricity in medicine was neither purely accidental nor empirical, for Pliny, in his "Historia Naturalis," logically deduced from the attributes of the torpedo fish that considerable therapeutic benefit might be derived from a creature endowed with such natural powers.

In 1747 and 1748 the now much-disputed theory of ionic medication was foreshadowed by the attempts of Pivati, of Venice, and Veratti, of Bologna, to introduce by electrical means the medicinal virtue of drugs, so that medicine might be made to act without being taken into the stomach. The theory attending such a procedure was at that time short-lived, for by reason and ridicule Priestley and others promptly demonstrated the fallacy of the theory. It was upon electrical shocks that Lovett, Wesley and Marat chiefly relied to obtain therapeutic effects by the administration of electricity, a view also supported by Franklin.

About 1780 the Abbé Bertholon, in a paper entitled "The Influence of the Electricity of the Atmosphere on Diseases," originated the theory that all diseases were due either to an excess or a deficiency of the electric fluid. The former he treated by drawing off the excess of the fluid from the back of the hand of an electrically charged patient, the latter by the simple static charge. Marat, the notorious revolutionist, in a very acrimonious disputation with the Abbé, rejected the idea that atmospheric electricity had any influence on the human economy. In his very interesting book Marat also definitely lays it down that artificial as opposed to atmospheric electricity alone possesses any therapeutic value. It was upon shocks and sparks from the static machine of his period that Marat relied.

In 1791 Galvani's great work on the excitation of muscular contraction by electricity was published. It should not be overlooked that Galvani himself distinctly states that he was induced to undertake this work in order to make electricity more safe in the treatment of disease. He at first maintained, as the result of his work on animal electricity, that the current came directly from the muscles and nerves themselves; in fact, he is stated to have held the view that he had in this way discovered the origin of life. The apparent restoration of function in the leg of a dead frog on the application of the galvanic current naturally led to its use for the restoration of the apparently dead. Valli, for instance, claimed to have restored to life fowls which had been drowned. The fundamental idea which appears to have obsessed the workers of that period was that the electrical force was life itself. Napoleon, indeed, went even further and was more exact and definite in his views, for, on seeing Volta's pile, he is reported to have exclaimed, "Behold the representation of life; the vertebral column is the battery, the bladder is the positive and the liver the negative pole."

The remarkable work of the great Englishman, Faraday, to the value of whose experiments perhaps the highest testimony is to be found in the extent to which many of his views and theories have stood the test of modern discoveries, paved the way for the accurate and valuable investigations of Duchenne, of Boulogne, which were of the greatest importance in laying a scientific foundation both for electrotherapy and neurology.

In this country Faraday's investigations instigated the scientific and philosophical researches of Dr. Golding Bird, of Guy's Hospital, into the action of electrical energy in its application to medicine. From this time until the commencement of the present century little, if any, progress was made in the rational explanation of the mode of action of electrotherapy. Attention was mainly directed towards the physical side of the question, to the design and invention of new apparatus. In this direction great progress was made, as is perhaps best shown by the far-reaching work of D'Arsonval, who commenced his experiments on the high-frequency currents in 1888. In this country it is difficult to overestimate the debt we owe to Dr. Lewis Jones, who by his courteous tact tided electrotherapy over a period during which it was viewed with great suspicion by the medical profession.

A perusal of Lewis Jones's writings gives me the impression that he was more interested in the physical than in the biological side of electrotherapy.

Partly as the result of the neglect of the biological and physiological aspect of electrotherapy by the writers of this period, and partly as the result of the blatant advertising of such apparatus as the "Harness electric belt," a quack and impotent instrument advocated by some of the leading members of the medical profession, we find that ideas relating to the curative action of electricity were exceedingly crude, indefinite and inaccurate; they had, I almost think, receded rather than advanced since the time of Duchenne and Golding Bird. As the outcome of this, electrical treatment was regarded by the general public as the administration of some mysterious vital force, the *vis nervosa* of the older writers, and the medical profession looked upon it largely as a form of treatment by suggestion, a form of treatment which in those days was scoffed at and held in scorn instead of being rightly extolled, as is the case at the present day.

Confirmation of this view is to be found in the more advanced books on electrotherapy of that period. Dr. H. Bordier, in the preface of his valuable book, "Precis d'électrothérapie," 1902, finds it necessary to refute the views of Moebius (Congres d'électrothérapie à Frankfort, 1893) that electrotherapy "rests altogether on suggestion," and of Crocq fils that "electricity frequently acts by suggestion" (Congres de med. de Bordeaux, 1895), and of Posenbach that "the cures which follow the application of electrical treatment are the result of natural causes" (Congres d'électrothérapie, Frankfort, 1893). The spectacular character of the high-frequency sparks naturally contributed to such views, but from these impressive discharges has developed the convincing method of diathermy.

In the foregoing remarks I am far from criticising adversely the earlier workers; the course of events has been in the natural process of evolution, for it is necessary to discover the physical methods, and we must possess the necessary apparatus before we can investigate their biological action.

During the past twenty years, in the absence of any striking innovation in our physical equipment, we have turned more to the consolidation of our position by studying the physiological and biological effects of the powerful and fundamental methods we possess of utilising electrical energy as a curative agent.

A study of the modern text-books of physiology and biology affords the electrotherapist a most encouraging outlook, and one pregnant with immense possibilities, when we consider the ever-increasing part which electrical energy is found to play in all vital phenomena. Contrast, for instance, the physiology text-book of twenty or thirty years ago with such a modern work as Professor Bayliss's "Principles of General Physiology." It is to the work of the physiologist and biologist that we have looked in the past few years, and must look more and more in the future, for the explanation of the action of electricity in medicine.

From the investigations of the physiologists we deduce that the action of the electrical current, especially in its interrupted forms, is mainly the outcome

of the relatively high velocity of the hydrogen ion. That is to say, the velocity of the hydrogen ion is so high compared with that of other ions, that when we abruptly make or increase in strength an electric current through the body, the hydrogen ions momentarily concentrate in excess of the normal equilibrium at the negative pole; thus a hydrogen ion, or acid concentration takes place at the negative pole and causes a muscular contraction or some phenomena of a sensory or other character in the neighbourhood of the negative pole.

When we break or abruptly decrease in strength an electric current already established through the body, the hydrogen ions have been travelling with such relatively high velocity from the positive pole that, at the moment of break, there is a temporary deficiency of them in that region, leading to an hydroxyl ion or alkaline concentration, which in turn excites similar phenomena in the neighbourhood of the positive pole.

Thus we see that the old idea of polar inversion is incorrect, for the contraction at make invariably proceeds from the negative pole, and the contraction at break from the positive pole; consequently there cannot be such a thing as A.C.C. or K.O.C., such contractions being in reality K.C.C. and A.O.C. deeply seated and diffused in the tissues, and this explains the sluggish and diffused character of the contractions so excited.

The more abrupt the interruption and the higher the voltage of the current, the more definite will be this hydrogen ion concentration and the more vigorous will be the resulting contraction.

A certain minimum duration of time is however necessary for a resulting contraction to take place, and the higher the voltage employed the more brief will be the minimum duration required to excite a contraction. These factors explain the phenomena of high-frequency and diathermy currents, for the reversals are so frequent that the duration of the current is insufficient to permit the necessary ionic concentration.

You will remember that D'Arsonval, in his original paper in 1888 on his investigation into the action of rapidly-interrupted alternating current, an investigation which led him to the discovery of the high-frequency currents, found that until 2,500 or 5,000 interruptions a second were reached, the voltage remaining the same, the resulting contractions increased in vigour as the frequency of interruption increased; but after reaching this frequency the vigour of the contractions decreased with an increase of frequency. It was not until two years later that D'Arsonval was able to obtain an instrument of sufficient frequency to abolish all contraction and sensation, thus obtaining the characteristic phenomena of high-frequency currents.

The theory of the hydrogen ion not only explains the more obvious phenomena of high-frequency and diathermy currents, but it also shows why some so-called high-frequency currents of very high voltage excite a certain amount of muscular contraction and sensation, the voltage of such currents being proportionately too high for their frequency.

We naturally and correctly conclude that the heat generated by these currents, which we find of such great and far-reaching therapeutic value, is

the result of the violent oscillation of the ions. Apart from the heat generated, there is, I am convinced, though the proof thereof cannot be so clearly demonstrated, a very valuable therapeutic action from the vibratory or oscillating character of the currents on the tissue cells, which is not only of a stimulating nature, but has a useful effect on accelerating diffusion through the various tissue membranes. We have also to consider a possible condenser effect on the tissue cells insulated by their non-conducting cellular membrane from the oscillations of the ions occurring in the electrolytic medium with which these cells are bathed. The very marked diminution of effusion which occurs in the direct path of the current when treating a recently sprained ankle or a Colles's fracture by diathermy, cannot be explained either by the heat generated by the current or by the pressure of the pads applied. If, for example, you take a bottle containing leaden shot, the orifice of which is closed by a parchment membrane with holes of sufficient diameter barely large enough to permit the passage of the shot, on inverting such a preparation the shot will not pass through, but on shaking the bottle violently some of the shot will be forced through the holes in the membrane by the force with which they bombard it, and the more vigorously the bottle is shaken the more quickly will the shot pass through. This simple illustration affords a possible explanation of what occurs with high-frequency and other electrical currents when the cellular membranes are bombarded by the ions conveying the current; the force of the bombardment and the rate of diffusion being directly proportional to the voltage employed.

The recurrent hydrogen ion concentration also explains that most interesting form of treatment, the Leduc current. We may not unnaturally expect striking results when we employ currents of high intensity or voltage, but we are hardly prepared for the very remarkable results which we can obtain from the rapid interruption of currents of such low intensity as one or two milliamperes.

The Leduc current is obtained by interrupting an unidirectional current of one or two milliamperes about 100 times a second. By utilising such a current, Leduc has claimed that he can produce experimentally in animals single contractions, tetanus, local anæsthesia, general anæsthesia, coma, paralysis of the heart and respiration, and finally death.

It occurred to me during the war to use this current in the treatment of the terrible and intractable pain of causalgia. The treatment was attended by unfailing and most marked success, and in a similar condition in an undergraduate last June, at the Radcliffe Infirmary, the treatment was completely successful in relieving the pain after all the usual methods available in the hospital had failed. In this connection it is interesting to note that in the Research Committee's report on the diagnosis and treatment of peripheral nerve injuries, referring to the treatment of causalgia, the following passage occurs: "Little benefit can be hoped for from electricity." This action of the Leduc current can be explained by the exhaustion of the sensory receptors by over-stimulation, a phenomenon similar to that of the fatigue resulting in the

recovering end plate of motor nerves from over-electrical stimulation, the over-stimulation in each case being occasioned by the frequently recurring hydrogen ion concentration.

When we turn to the consideration of the constant or continuous current the matter is not so simply explained, for we have to deal with it in two parts: (1) its polar and peri-polar action, and (2) its inter-polar action. The velocity of the hydrogen ion does not in this case play so dominating a part, for when the current is established and undergoes little or no variation in intensity, there is no marked disturbance in the equilibrium of hydrogen ion concentration. The higher velocities, however, of the fastest kation (the hydrogen ion) and the fastest anion (the hydroxyl ion), and the immense numbers of these ions, render them by far the most important factors in the conveyance of the current through the electrolyte of the body, for the conductivity, and conversely the resistance, of an electrolyte depends on the number of the ions present and their velocities. Such an overwhelming proportion of the current is carried by the hydrogen and hydroxyl ions when transmitted through the tissues, that the once cherished theory of ionic medication is impossible of realisation; the path of by far the least electrical resistance being by means of the tissue ions, the medication ions of far lower velocity, and far less numerous, have only a negligible share in the transport of the current and are consequently introduced in an almost inappreciable quantity.

Considerable time must necessarily elapse before a theory so widely held as that of "ionic medication" can be fully eradicated, but even those who still hold this theory have very considerably modified their views; the theory of the deep penetration of medicated ions has been entirely abandoned, and the very small amount of the drug capable of being introduced beneath the cuticle has been more accurately stated. A distinguished French worker ("Dosage de l'iode introduit et éliminé dans l'ionisation," G. Bourguignon, p. 217, *Journal de Radiologie et D'Electrologie*, Mai, 1923) has recently attempted to show that superior results are likely to result when iodides are electrically introduced than when they are administered by the mouth, because in the former case he claims that they are more slowly eliminated. Unfortunately, although his experiments to show the slow elimination of iodides, when electrically introduced, were most carefully performed, no control experiments were made to show the time of elimination when iodides were taken by the mouth. Reference to pharmacological literature, however, shows that the iodides are in part slowly excreted when taken by the mouth. Most of a single dose is excreted within a few hours, but the remainder is eliminated very slowly. With a dose of seven to fifteen grains the iodide reaction persists in the urine for forty hours; after larger doses or continued administration traces persist for twenty days. With a single dose of fifteen grains administered to a man, 80 per cent. was excreted in twenty-four hours, and 20 per cent. between twenty-four and forty-eight hours. Iodised fats and fatty acids given by the mouth are eliminated even more slowly, so that, even if the theory of the slower elimination of the electrically introduced iodides were proved, which in the absence of

control experiments is certainly not the case, nothing would be gained, for a still slower excretion can be obtained by the more simple procedure of administering iodised fats by the mouth.

In regard to the polar and peripolar action of the constant current, much misapprehension has arisen from a loose and erroneous terminology; when we speak of zinc or copper ionisation, we are in reality referring to a process of de-ionisation rather than one of ionisation. Since the current beneath the cuticle is mainly carried by the tissue ions, those ions conveying the current from the pad or electrode to the surface of the body, on reaching the superficial tissues, are free to enter into combination with the chlorine, oxygen or other ions set free by the electrolytic action at the poles. The process would, I think, be better and more correctly termed "electro-deposition"; it is analogous and in every way comparable with electro-plating, except that a caustic compound is so deposited instead of an inert metal. And, like electro-plating, the deposition takes place on the superficies of every crack, crevice, and cavity of the surface treated.

This powerful, permeating caustic action, limited in its depth penetration, renders this process the safest, simplest, most thorough and most valuable method for the treatment of septic surfaces, sinuses and cavities. Its general adoption in the past appears to me to have been hindered by its consideration chiefly in reference to its application to special parts and regions under distinctive and bewildering titles, such as the treatment of gonorrhœa by electrolysis, the electric ionisation of otitis media, the treatment of endometritis by zinc ions. A different name in each case for fundamentally identical methods. No wonder that confusion exists in regard to the value of this treatment!

If we clearly define the fundamental principle upon which this treatment is based, namely, the superficial deposition by electrical means of a caustic agent, not only electrotherapists, but even the surgeons themselves will be able to realise the value of its application to every suppurating or indolent surface, to suppurating sinuses, and to the diseased lining of every accessible cavity of the body. Dr. Golding Bird, who with Sir Thomas Spencer Wells introduced this form of treatment about the year 1849, more clearly realised and explained its mode of action than many modern writers on the subject.

We have been too inclined in the past to regard this merely as a surgical action of the constant current; and to disregard the importance of this polar action when administering the constant current for medical purposes. When we use solutions of less caustic and irritating substances, such as sodium salicylate, sodium chloride, quinine sulphate, we obtain a varying stimulation in place of a caustic action on the skin, and this directly and reflexly influences our treatment to the possible benefit of our patient. In this way may be explained the difference in results obtained by some electrotherapists when using different solutions with which to moisten their pads; for instance, the superior results claimed in the treatment of tic dolooureux when soaking the positive pad with a solution of quinine sulphate.

In reference to the above point, I have recently performed a series of experiments, which simple as they were, are not, I think, without interest.

I will not weary you with all the details of the experiments, but will briefly refer to their essential points and the conclusions I draw from them. The patient treated was an intelligent and tolerant man, suffering from early rheumatoid arthritis of both knee joints. Electrodes and pads of the same size were similarly placed in each experiment, eight thicknesses of Turkish towelling were employed, new pads being used for the different solutions. A voltage of 6.3 was employed in each case, the regulating resistance being quickly and evenly reduced so that this voltage was reached in three seconds. The following solutions were in turn tried under their active poles: distilled water, Oxford tap water, 2 per cent. sodium chloride, 2 per cent. sodium salicylate, 2 per cent. quinine sulphate in 2 per cent. H_2SO_4 , 2 per cent. potassium iodide in tap water, 2 per cent. potassium iodide in distilled water. A 2 per cent. solution of sodium chloride was used to moisten the indifferent pad in each case. Records were taken of the milliamperage as soon as the maximum voltage of 6.3 was reached, and again in five, ten and fifteen minutes. The first or three-second reading did not vary much with the drug employed, usually amounting to 3 or 4 ma. In ten or fifteen minutes the milliamperage obtained with 2 per cent. potassium iodide was about double that obtained with tap water. With the potassium iodide the skin was more reddened, was more irritated, and more discomfort was experienced by the patient than with tap or distilled water at this given voltage. Quinine sulphate dissolved in dilute H_2SO_4 produced still more irritation, redness and discomfort. If the area treated was thoroughly well warmed by diathermy before the constant current was applied, nearly the maximum milliamperage was at once recorded and varied far less with the solution employed. It would therefore appear that the milliamperage obtained depended more upon the dilatation of the cutaneous vessels and the consequent diminished skin resistance than upon the velocity of the ions with which the pads were moistened; that is to say, that the more irritating the polar action of the drug the greater will be the counter-irritation, the greater will be the cutaneous vaso-dilatation, and the higher will be the milliamperage obtained. Thus, where superficial pain is under treatment, the best results at a given voltage may be obtained by utilising a solution which causes considerable counter-irritation, such as quinine sulphate in dilute H_2SO_4 solution. The increased efficiency which some workers have experienced in the treatment of tic douloureux by moistening the active pad with a solution of quinine may be thus explained. By increasing the voltage, however, we shall obtain with less irritating solutions a similar counter-irritation and vaso-dilatation, and such solutions may be preferable in the treatment of deeper parts, where the interpolar action of the constant current is desired. It would further appear that the polar action thus obtained is not due to any specific therapeutic action of the solution employed, but is merely the measure of its irritating action. When, after a previous heating by diathermy, a relatively high milliamperage was obtained,

it was found when using quinine solutions that the voltage of 6·3 had to be reduced on account of the irritation produced. It should be realised, however, that this irritation is not due to the quinine ions, but to the 2 per cent. solution of H_2SO_4 in which the quinine is dissolved. This counter-irritation at the polar surfaces is certainly a very important point, but it is not the only point to be considered.

Considerable heat is necessarily generated when such large currents as those of 100 ma. are passed through a limb for forty-five minutes or more, as is frequently done in modern electrotherapeutic practice. The fact that this heat is mainly generated in the skin, where the resistance is greatest, does not materially affect the question, for it can be shown by placing a surface thermometer well removed from the pads that the whole temperature of the limb is raised two or more degrees. It is quite unnecessary for me to dwell upon the consecutive benefits which must result from the application of such heat throughout a wasted, atrophic sciatic limb with its subnormal temperature. Moreover, the increase of temperature induced by prolonged intensive application of the constant current, with its consecutive increased circulation and improved nutrition, cannot be overlooked in explaining the benefits which we all of us see after treating such conditions as rheumatic knees in this manner. The unidirectional movement of the ions moving and colliding with such aggregate force as to produce this amount of heat must have some effect, though to what extent it is impossible to estimate at present, in accelerating the diffusion through the various membranes in the interpolar path.

To sum up, current electricity, in its slowly interrupted form, exercises a stimulating action on the cells in the path of the current, the excitation of contraction being a manifestation of this stimulation, both this stimulation and contraction being the result of hydrogen and hydroxyl ion concentration.

By greatly increasing the rate of interruption we are able to annul the effects of this hydrogen and hydroxyl ion concentration, and so are enabled to produce any desired degree of heat in the tissues with a complete absence of chemical stimulation. In addition to this heating effect, the kinetic action which produces it has a valuable influence in accelerating diffusion through the tissue membranes. The action of the constant current depends upon its caustic or stimulating effects and its reflex irritation at the poles, on the heat it generates, and the diffusion it facilitates in its deeper interpolar path.

Viewed in such a way as this, we can visualise how electrical energy in the form of current electricity acts as a curative agent, and we can both predict in what conditions it will produce beneficial effects, and by what means and by what mechanism these effects are brought about. In such a way, and in such a way only, can we practise our speciality in a scientific manner, in a manner convincing to ourselves and to the medical profession.

If electrotherapy merely consisted in cataloguing the various forms of treatment, with the various diseases they are said to cure, such as, for chilblains the faradic current, for rheumatism ionic medication, it would cease to be a scientific and progressive method, and could equally well be practised

by any masseuse as by the most highly-trained medical man. But an empirical procedure such as this cannot be as successful as the scientific one, until Nature alters her whole scheme and makes each disease and ailment respectively amenable to one specific method of treatment.

When we turn our attention to the curative action of radiant energy, we are brought face to face with a mass of problems so diverse and so numerous that it is almost impossible to take even a bird's eye view of them this evening. As Guilliminot says, Nature has provided us with an enormous keyboard of vibrations for curative purposes, extending from the infra-red to the gamma rays of radium.

Provided that we do not imagine that the line of demarcation is a sharp one, and that the adjoining divisions do not largely overlap, this keyboard may be divided for practical purposes into radiant heat, light, ultra-violet radiation, X rays, and gamma radiation.

The most discussed portion of the radiant heat and light treatment at the present time is that of heliotherapy. The value of this treatment is admitted by all; every medical man in general practice has seen diseases caused or aggravated by its absence and cured or relieved by its presence. Its curative action is apparently due to a stimulating action on the skin and its glands brought about by radiant energy, that is to say, the consecutive effects are increased cutaneous circulation, increased cellular activity, increased cutaneous nutrition.

The superior results in some cases following heliotherapy would appear to be due to its more powerful actinic action, more effectively exciting chemical changes in the cells or other tissues by which its radiation is absorbed.

The pigmentation of the skin in Addison's disease, the dermatographic lines so readily induced in Graves' disease, the increased translucency of the skin of tadpoles, when these embryos are fed on pineal gland, all tend to show an intimate relationship between the skin and the endocrine glands. It has, indeed, been suggested that "the pineal influences the body by varying the degree of light reaction." (Berman.)

The results obtained from heliotherapy in rickets are very suggestive of an increased liberation of hormones. The reaction of the skin to stimulation by electrical energy calls for further investigation; the skin has been for too long regarded by the medical profession as merely a thing of sores and pimples.

In connection with U.V.R. and X rays, I should like to emphasise the importance of Kohler's experiment on the gill plate of the salamander larva. Kohler obtained, by means of ultra-violet radiation at $\lambda 2,800$ A.U., photographs of the dividing nuclei in the gill plate of the salamander larva, in which the chromatic substance was so opaque as to appear stained, showing that the chromatin absorbed the radiation to a very marked degree before the other tissues arrested any appreciable amount. Now this is a very significant fact, when we remember that light and other radiations are only effective when some of their energy is absorbed, and that the cells, when their nuclei are in a

state of division, that is, when the chromatin is most in evidence, are far more receptive to the X rays. It is, indeed, this selective reception of the cells when undergoing mitosis that enables X rays to be utilised as a curative agent.

It appears to me that the attention of most radiologists is too much directed at the present time to the lust for a more and more powerful radiation. The mere clinical worker would think that when a radiation of sufficient power and penetration to cause ulceration and perforation of the bladder and bowels had been obtained, that enough had been achieved in this direction for the present, and that more attention might now be turned to the far more important question of the fundamental biological action of X rays; for until this question is settled X-ray treatment must of necessity be largely empirical.

Moreover, in the pursuit of the more penetrating radiation we seem to have reached a deadlock, at any rate as far as the treatment of cancer is concerned. For though the radiations may have sufficient power to destroy cancer cells in one part of the body, if the treatment is applied to more than one region for the destruction of disseminated cells, the patient dies from resulting blood changes. Hence it is clear the difference between the radio-sensibility of the cancer cells and the blood cells is insufficient to enable a cure for cancer to be found by merely increasing the power of radiations. We may be able to cure cancer by X rays, if it is not disseminated, but the mere surgeon can do that.

Possibly further success may be achieved in the radiotherapy of cancer by the discovery of some means of increasing the mitosis of the cancer cells, and hence their radio-sensibility, previous to the administration of the lethal X-ray dose. An increase in the radio-sensibility of the skin can be readily obtained by the previous administration of U.V.R. In treating acne, for example, I found some time ago that after the application of U.V.R. the application of X rays in about one-third of a pastille dose produced a definite erythema. Rapp (*Strahlentherapie*, Vol. XII) also, although his experience was less fortunate, points out that he has seen burns of the second and third degree due to a combination of U.V.R. and X rays.

No photo-sensitiser or other substance capable of increasing the radio-sensibility of cancer cells has yet been discovered, and apparently the most we can say in this connection at present is that in X rays we have an agent capable of destroying cancer cells, but that the technique of their efficient administration in the cure of cancer has yet to be discovered.

It is quite unnecessary for me before such an audience as this to recite in detail the special diseases and conditions in which electrotherapy is indicated, but I should like, if I may be permitted to do so, to direct your attention very briefly to a most important field of research in relation to electrotherapy, to the threshold of which we have as yet barely approached. It is one which I believe is capable of yielding most far-reaching results. I refer to the power which electrotherapy places at our disposal for both stimulating and restraining the action of the endocrine glands.

This action can only be exercised to its full extent when we possess a complete knowledge of the action of the endocrine glands, and in the application of such treatment we need the active co-operation of the biologist and serum therapist.

In the static charge we have an efficient means of stimulating the adrenal glands, and their excitation in this way explains the beneficial effects of the static charge in neurasthenia, a form of treatment advocated years ago by Charcot, and more recently by Benham Snow and other American writers. It is of interest to note that an American biologist, referring to neurasthenia, which he terms "the great American disease—dementia americana," states that it "seems to be adrenal disease." (Berman.)

By diathermy or galvanism we have the means of stimulating such glands as the thyroid, and in X rays it is well established that we have the means of restraining the action of this and other glands.

With such powerful agents at our disposal, it is surely but a matter of time and research to acquire an increasing control over the many and varied diseases arising from a disordered action of the endocrine glands.

From this very incomplete review of electrical energy as a curative agent it is evident that much has been accomplished in the past, but that far more remains to be done in the future. We are, indeed, but on the threshold of our science; before us is opening up a vista of possibilities unequalled in any other branch of medicine. Electrotherapy certainly at the present time does not meet with its due recognition, but its unexplored field for investigation is so immense that any careful worker may attain in some degree to the true goal and reward of the research student, so well expressed in the lines of Wordsworth:—

"Enough if something from our hands have power
To live and act, and serve the future hour."

CRANIAL RADIOGRAPHY.

By ROBERT KNOX, M.D.

(1) THE RADIOGRAPHY OF THE SELLA TURCICA.

(Continued from November issue, p. 183.)

THE SELLA TURCICA IN DISEASE.

A certain latitude must be allowed in the all-round measurements. There will be a slight variation in the measurements of the sella in skulls of different sizes. This will, however, bear a definite ratio to the size, and if, when estimating the size of the sella, the circumference of the skull is taken, it will be possible to say when the increase in the size verges on the pathological.

There are two chief conditions in which enlargement of the sella is a prominent feature. These are in acromegaly and tumour arising in the pituitary fossa. In acromegaly the primary change takes place in the pituitary body. This enlarges and the increase in size is uniform. The sella will be gradually and equally distorted. The form of the sella is unaltered, there may even be an apparent division of the fossæ differentiating the two parts of the pituitary body. The effect upon the other structures is important: the wall of the sphenoidal sinus is encroached upon, and in advanced cases of tumour it may be obliterated. The sphenoidal sinus may therefore be altered from three causes: (1) increased pressure upon the walls of the sella turcica from enlargement of the pituitary body; (2) pressure from without; and (3) from the presence of collections of fluid or tumour within the sphenoidal sinuses.

DISTURBANCES RELATING TO THE SECRETIONS OF THE PITUITARY BODY.¹

The pituitary body is composed of an anterior glandular portion, a pars intermedia, containing both glandular and nervous elements, and a posterior nervous portion, which is a continuation of the infundibulum. The glandular portion to some extent recalls the structure of the thyroid, since at times the cell collections take on a vesicular arrangement, the vesicles containing colloidal material. This colloidal material may escape or be passed through the intermediary and nervous portions into the third ventricle of the brain. It is the posterior particularly, and to some extent the intermediary portion, which produce an extract or hormone, capable, like that of the medulla of the adrenal, of causing a great rise in blood pressure, a rise more prolonged than that produced by adrenalin. In addition, the extract produces a marked polyuria, and, as has been shown, has a pronounced galactagogue effect, causing an extraordinary increase in the secretion of milk. As shown by Cushing, stimulation of the posterior part is followed by glycosuria, removal by an opposite condition of increased tolerance of sugar. The effects of pituitary disease vary according as to whether they manifest themselves (1) prior to, or (2) after, adult stature is attained. Growths present in early life in the glandular portion, such as lead apparently to increased activity, are found accompanying a large number of cases of giantism. Such growths developing after adolescence are associated with the remarkable condition of acromegaly.

Acromegaly is a dystrophy characterised by abnormal processes of growth, chiefly in the bones of the face and extremities. The term was introduced by Maice, and signifies large extremities. It occurs more frequently in women than in men. The affection usually begins about the twenty-fifth year, though in some instances as late as the fortieth. It is characterised by well-marked symptoms. The hands and feet are greatly enlarged. The head increases in volume, but not so much in proportion as the face, which becomes elongated and enlarged in consequence of the increase in the size of the superior and the

¹ Adami and Macrae.

inferior maxillary bones. Ocular symptoms are common; Hertzels analysed 175 recorded cases, 92 of which presented eye complications. In three-fourths of these the optic nerves were affected, usually atrophy, rarely neuritis. Bitemporal hemianopsia is often an early symptom, and the disease may persist for twenty or more years.

Pathological Anatomy.—Woods-Hutchinson has recorded 262 cases with 77 autopsies, in only four of which the pituitary gland was not involved. The change in the pituitary body is a progressive one. The gland continues active, but the duct is obliterated. The secretion is absorbed by the lymphatics. The gland increases in size. The chief development is downwards and forwards. The clinoid processes retain their relative positions, at least in the early stages. The outline of the sella turcica is uniform, and for a time retains its normal shape. The sphenoidal sinuses are encroached upon, and in the later stages the walls may approximate. It has been suggested by Massalongo, and others, that gigantism and acromegaly are one and the same disease, both due to the superfunction of the pituitary gland.

This disease is characterised by increased development of the bones, more particularly of the face and the extremities, though the whole bony skeleton is apt to be involved. With this overgrowth there is a corresponding development of the surrounding tissues. With enlargement of the maxillary and mandibular bones, the nose broadens, lips, ears and eyelids enlarge. The hands and feet are enlarged. Other "neighbouring phenomena," such as hemianopsia and blindness, are due to pressure of the enlarged pituitary upon the neighbouring parts.

The opposite condition of hypopituitarism, if occurring in early life, is found associated with a form of infantilism and dwarfism with arrest of sexual development, with or without pronounced obesity, increased tolerance of sugar, and at times liability to epileptic attacks. (*Dystrophia adiposa genitalis.*)

Disease of the pituitary gland is now regarded as the most probable cause of acromegaly. The gland may be the seat of a simple hyperplastic enlargement with little apparent alteration in structure, or in other cases carcinoma or sarcoma may be present. Cystic changes, fibrous atrophy, and gummatous and tuberculous disease have each been described in certain of the cases, but appear to be less common causes of the disease. The sella turcica is usually very considerably enlarged, and, in the case of malignant tumour of the gland, the bones and the base of the brain may become infiltrated by the growth. Involvement of the optic nerve or commissure may lead to the occurrence of bitemporal hemianopsia already mentioned, or even complete optic atrophy.

TUMOUR OF THE SELLA TURCICA.

Nature.—There are fibroma, myxo-fibroma, sarcoma, carcinoma. The presence of a new growth in the sella turcica leads to the following changes: (1) Increase in distance between the clinoid processes; (2) unequal enlargement of the cavity; (3) destruction of the walls of the sella.

Tumours in the Region of the Sella originating outside the Sella Turcica.—These may produce focal symptoms in some respects similar to the symptoms of intersellarous tumours, but from their position and spread the symptoms may differ considerably; unless the tumour directly involves the duct and by pressure obliterates it, the leading symptoms may not be those generally associated with acromegaly. The optic nerves may, however, be involved.

THE SELLA TURCICA IN NORMAL CHILDREN.*

The following conclusions are arrived at in a paper under the above heading :—

1. *Shape and Size of the Sella Turcica.*—The sella turcica in normal children can be classified in a general way by means of the roentgenogram into three groups: A, circular; B, oval; C, flat and square-shaped, with modifications explained in the text. Groups A and B were found in all ages, while group C was practically limited to the first three years.

2. *Shape of Sella as to the Size of the Head.*—The shape of the sella has no significance except in the case of the flat C type. This type is always found in small heads, but it does not necessarily follow that all small heads exhibit this type.

3. *Size of Sella in Comparison with the Age of the Child.*—There is a marked variation for each age, both as to height and length of the sella for the particular age. The average breadth and length of the sella shows a comparatively rapid increase in the first two years, with a gradual yet irregular increase from then up to the age of twelve. There is a tendency for the average height increase to follow the average length increase.

4. *Size of Sella as to Size of the Head.*—There is apparently no relationship between the size of the head and the size of the sella based on head measurements.

5. *Appearance and Size of the Sella as to Sex.*—There is no difference in the occurrence of the three groups between the heads of boys and girls. There does not seem to be any influence of sex on either appearance or formation of the sella. The sella of girls, however, were greater in both length and height.

* "A Roentgenographic Study of the Sella Turcica in Normal Children," Manning B. Sudar, M.D., F.A.C.R., and A.L. Loomis Bell, B.S., M.D., *Endocrinology*, January, 1923.

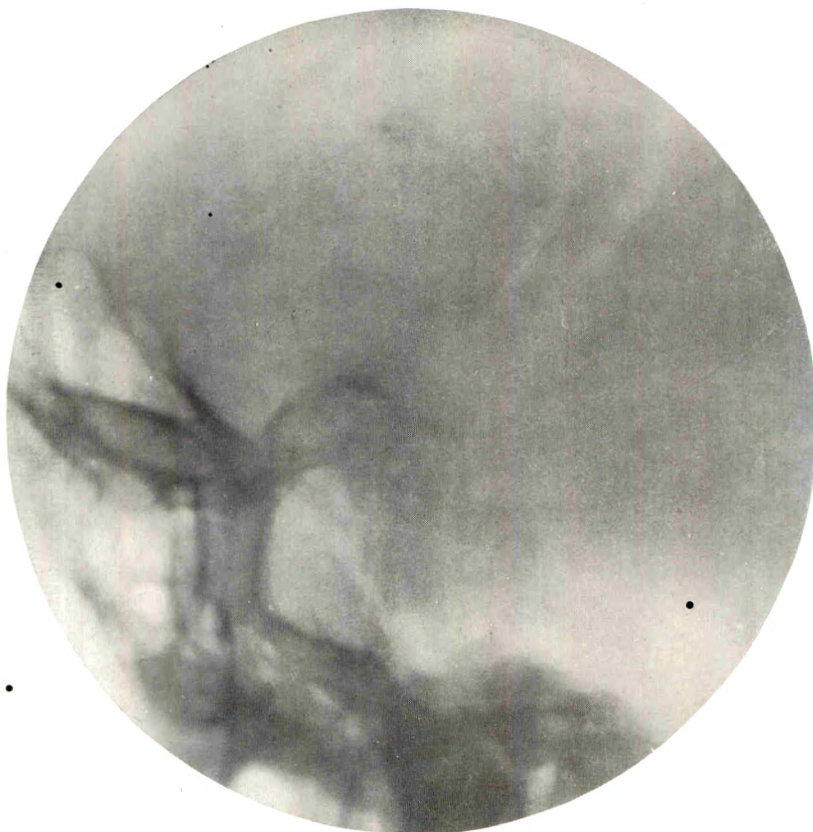
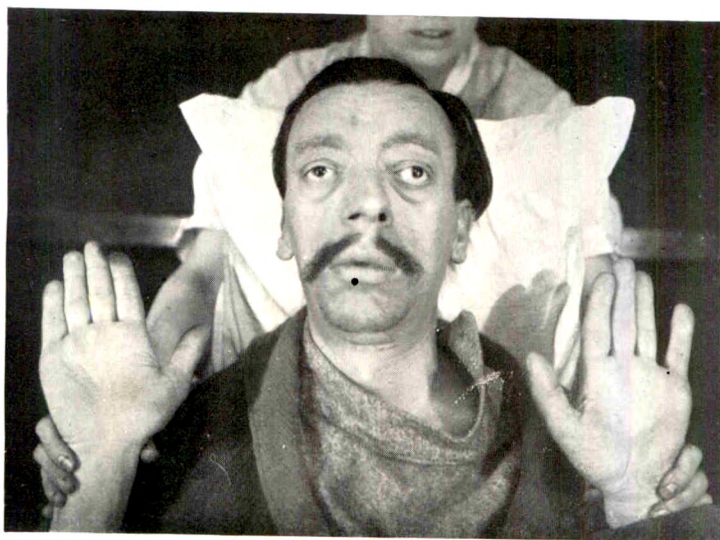


FIG. 19.—Marked deformity of the sella turcica region from the presence of a large central tumour. Note angular deformity of the sella.



A.

FIG. 20.—Photograph of patient before the onset of the illness.



B.

FIG. 21.—Photograph when skull was X-rayed.

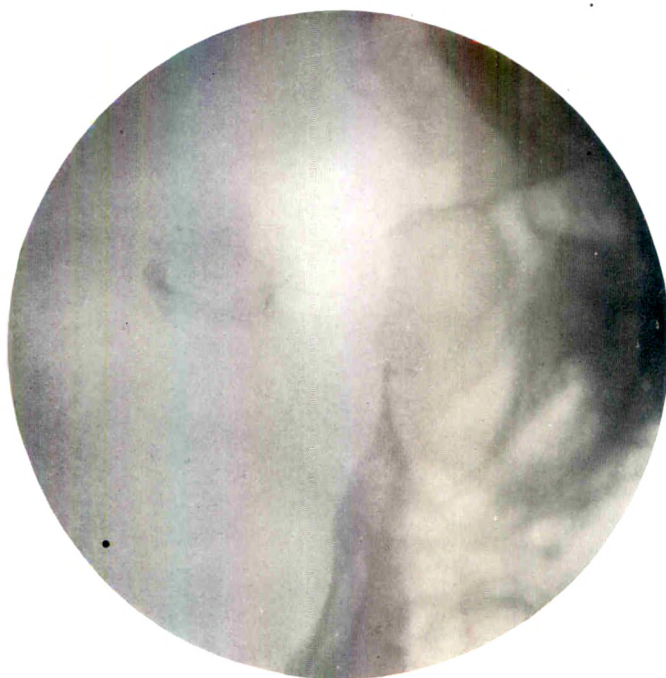


FIG. 23.

Unequal bulging of the sphenoidal sinuses.

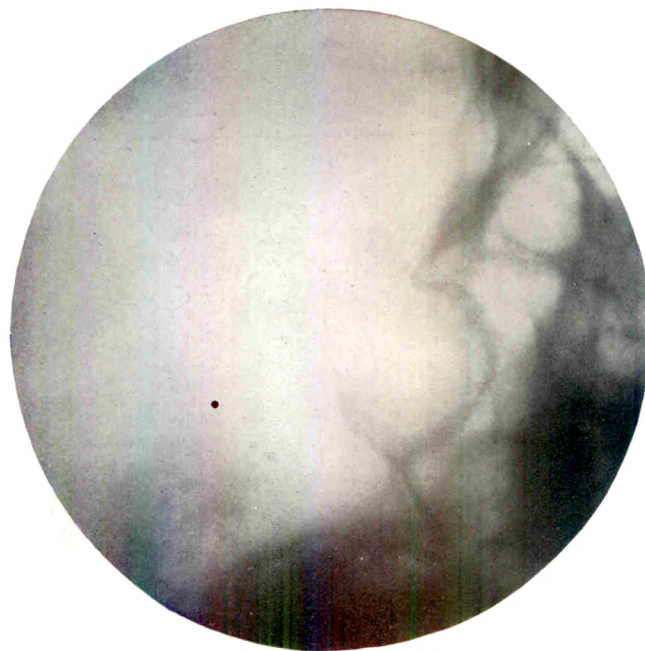


FIG. 22.

General and fairly uniform enlargement of the sella. Posterior clinoid process is intact.

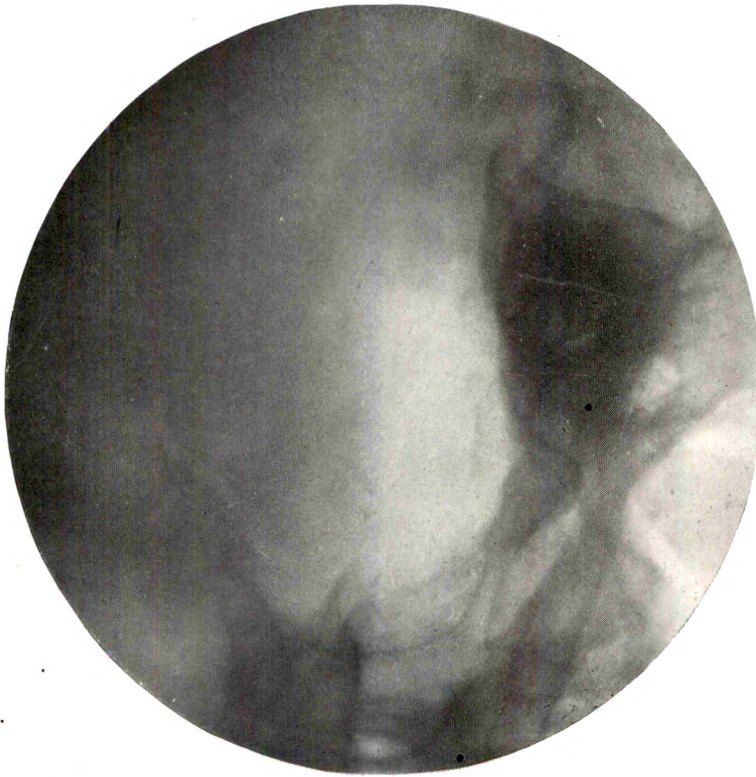


FIG. 24.

Two views of a tumour involving the pituitary fossa, radiographed with head on right and left side, with an interval of time between. Separation and widening of the anterior clinoid processes. Destruction of the posterior clinoid process. Excavation of the sella with irregularity of its walls. Almost complete obliteration of the sphenoidal sinuses.

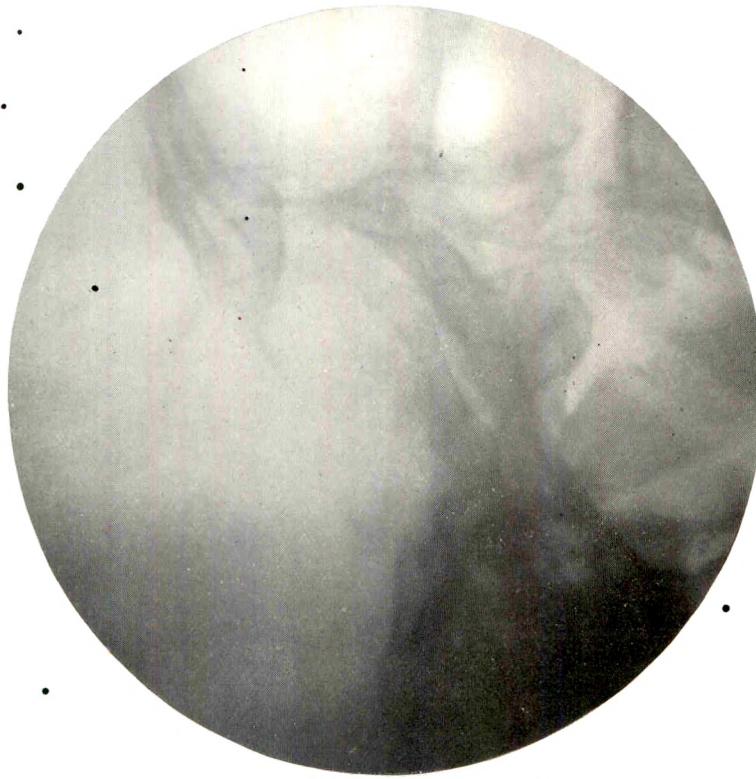


FIG. 25.

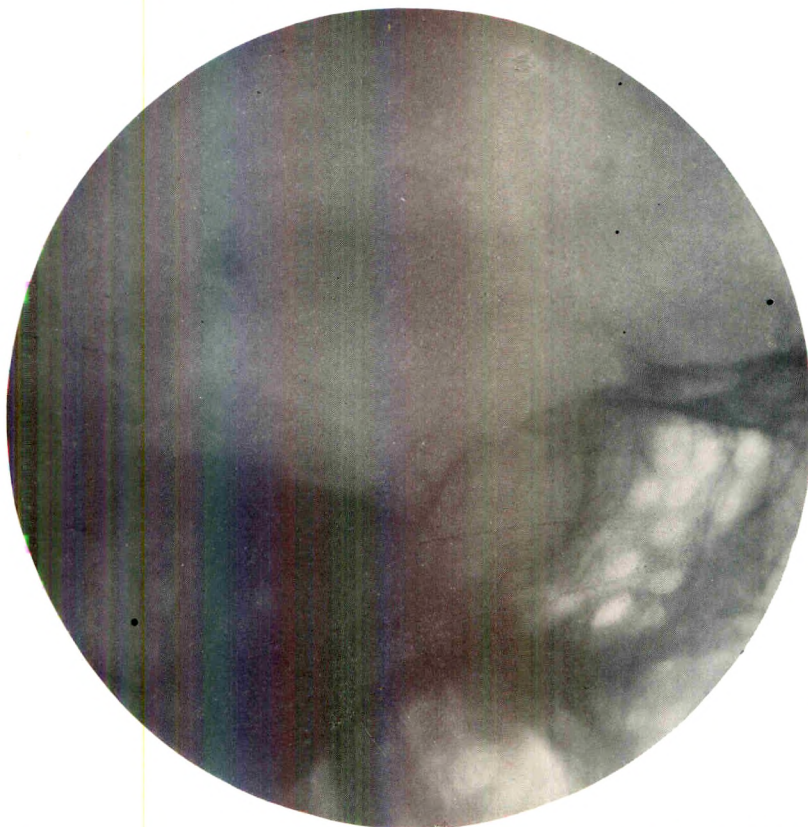


Fig. 26.—A. Moderate enlargement of the sella turcica. Relative position of the clinoid processes unaltered; increase in the depth of the fossa.



FIG. 27.—B. Hand of the same patient showing characteristic changes.

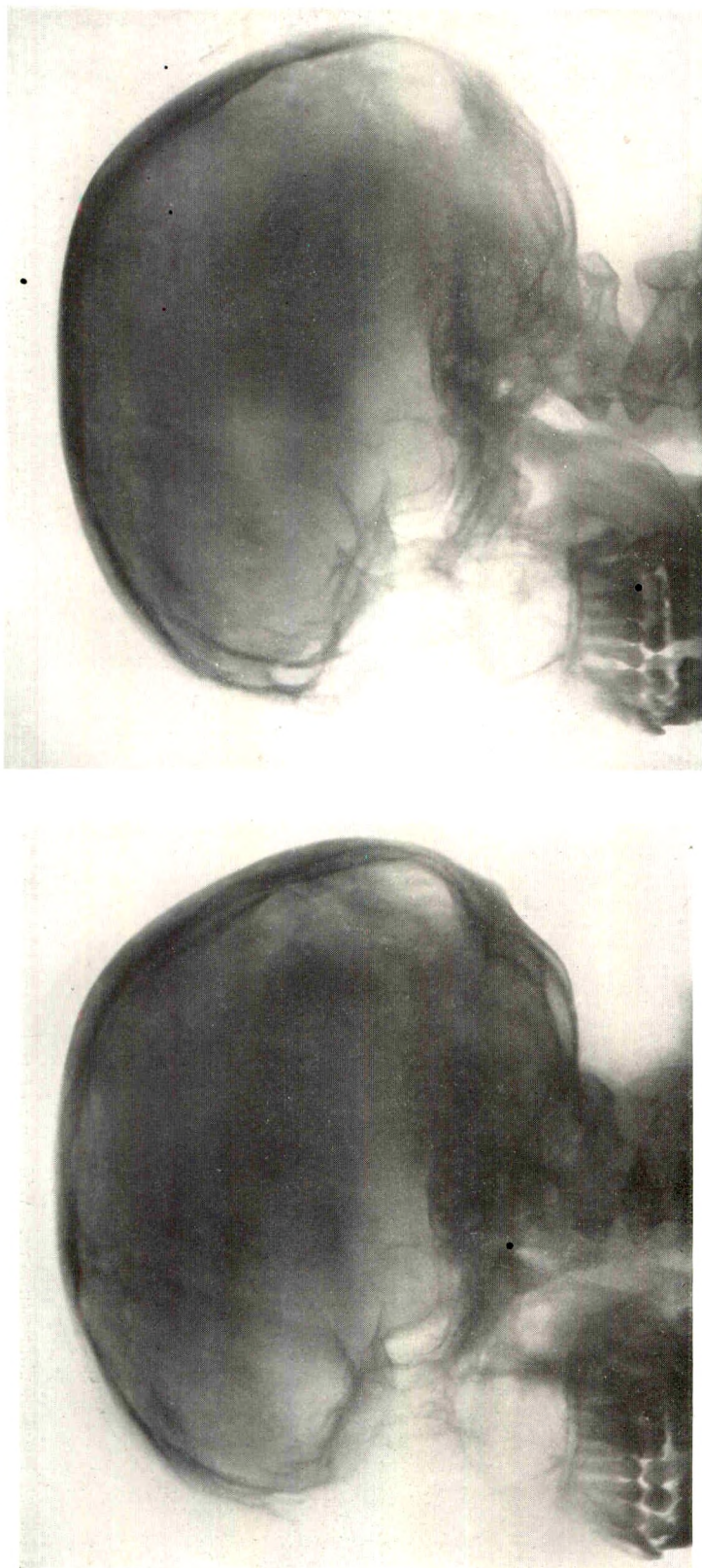


FIG. 28.—Stereoscopic radiographs of a large pituitary tumour. This patient had typical eye symptoms.



FIG. 30.—Moderate enlargement of the sella turcica. Marked deformity of the posterior clinoid process.

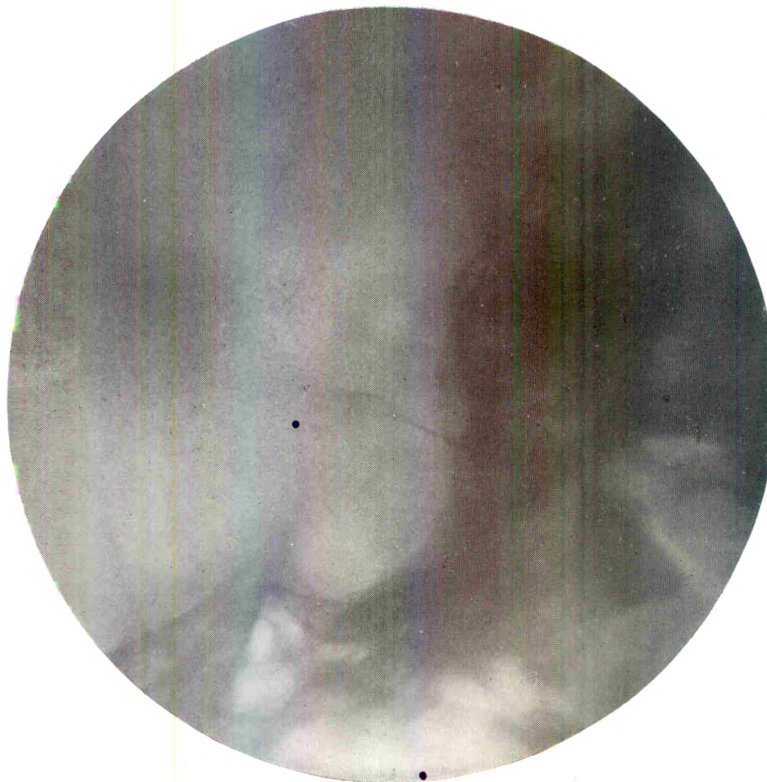


FIG. 29.—A large pituitary tumour. Widening of the space between the antrum and the posterior clinoid process. Thinning of the walls of the sella. Pressure effect on the sphenoidal sinuses. The latter are almost obliterated.

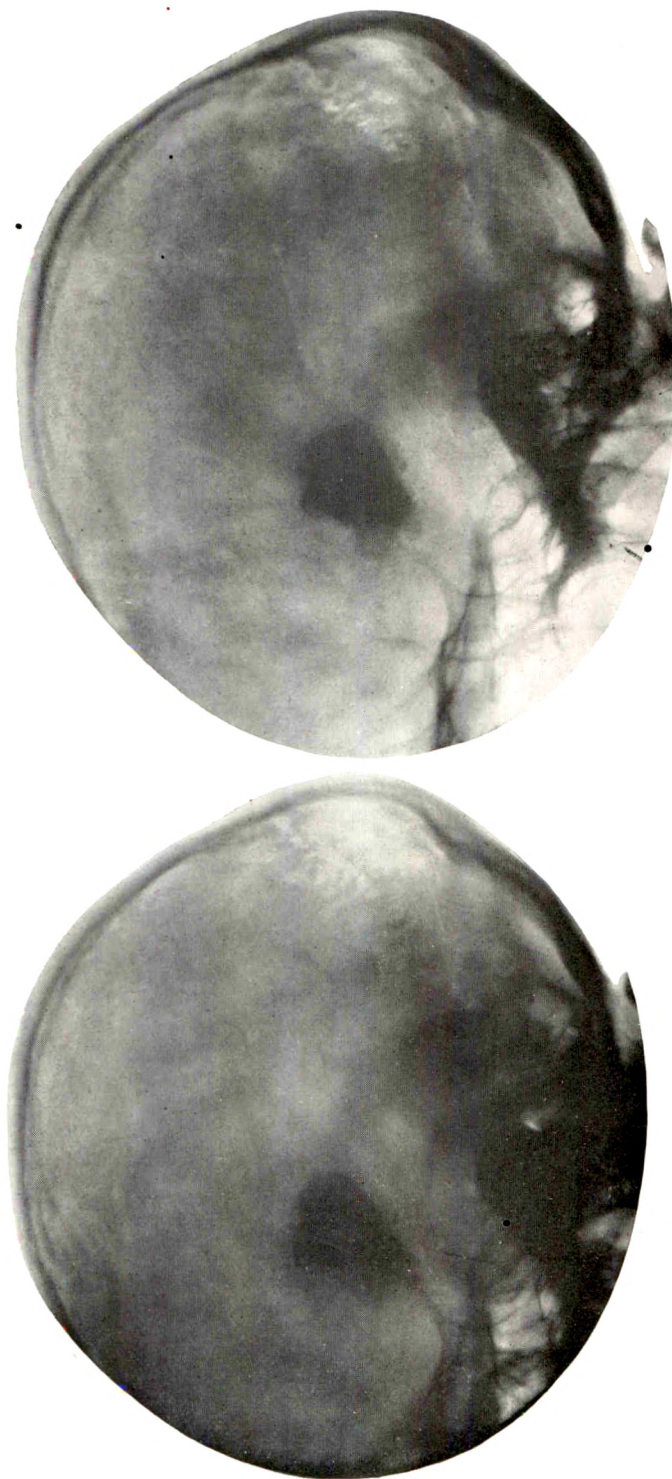


FIG. 31.—Tumour of the brain, situated above the pituitary region.
Stereoscopic radiograms.

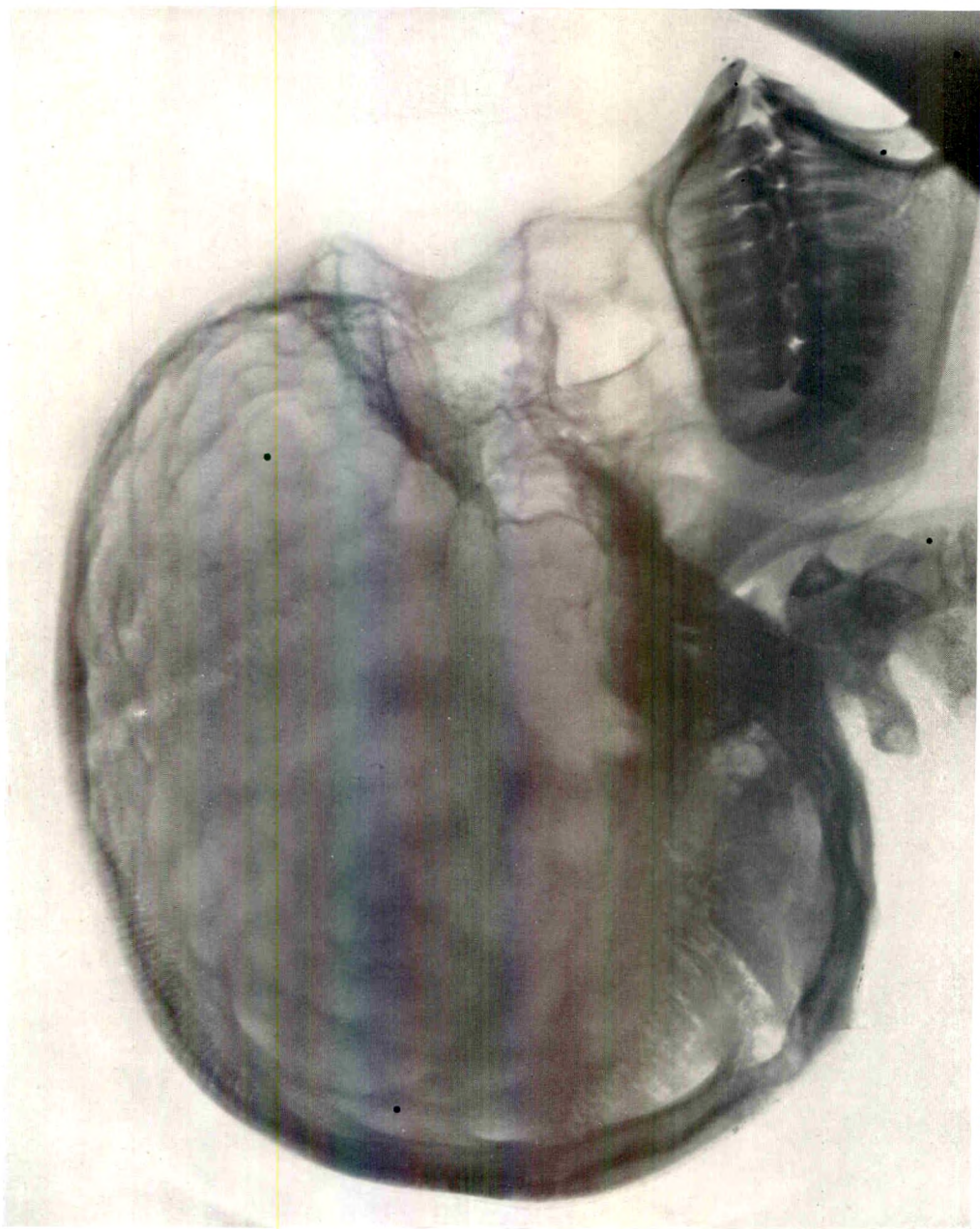


FIG. 32.—Pituitary tumour. Pressure symptoms and blindness. Note the enlarged sella turcica, the partial destruction of the clinoid process and involvement of the sphenoidal cell, also the atrophy of the skull—"hollowing out" of the inner plate. Reproduced with the kind permission of the Medical Officer, Major K. E. Wright, I.M.S.; radiographed by Capt. T. W. Barnard, M.S.E., Radiologist, X-ray Institute, Madras.

EXTENSIVE OEDEMA FOLLOWING INTENSIVE X-RAY TREATMENT: A WORD OF WARNING.

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THE following case illustrates one of the dangers that are liable to arise after modern intensive irradiation of certain regions, and is, I think, worth recording for that reason. The patient was referred to the X-ray Department by Mr. Wilson Hey. Her notes are as follows:—

S. B., female, aet. 57 years. The radical operation for amputation of the left breast was performed for the removal of a carcinoma in April, 1922. She received no post-operative X-ray treatment. The following October she had pains in the left upper arm and shoulder. During March, 1923, she noticed a small lump in the left supraclavicular region, for which she sought advice. This was diagnosed as a recurrence, and she was referred to the department where deep therapy was advised. The first application was made on April 4th, and each side of the neck was treated with a beam focussed laterally. A full erythema dose was given on each area. Within three weeks the patient had a marked skin reaction, which was accompanied by a slight peeling. She also complained of a very dry throat, and on examination it was found that she had a distinct membrane covering the fauces and soft palate. She was immediately examined for diphtheria, but the examination was negative. At the same time some hoarseness developed, and deglutition was difficult for a week or ten days, owing to the dry throat, which persisted in a minor degree for some weeks.

When seen twelve weeks later she still had the hoarseness and the glands were still palpable, so it was thought advisable to administer further treatment. On this occasion two applications were given from front to back on the affected side, and all hollows were filled up with plastic wax (Martindale). Again a skin dose was given, but the right side was not treated. When seen a month later the patient exhibited a remarkable oedema of the cervical region. This oedema extended vertically from the episternal notch to the submental region, and was not of the brawny type. She still complained of hoarseness and also of a lump in the right armpit. On examination during July it was found that the right breast had become affected and that there were secondaries in the axilla. X-ray examination of the chest showed no metastases, but there was a curious even opacity of both apices, which was diagnosed as oedema extending down into this region. As it was thought that the hoarseness was due to an atrophic condition of the laryngeal mucous membrane, the patient was referred to the aural department, which reported that there was a bilateral abductor paresis due to recurrent laryngeal pressure,

and that there was no local disease in the larynx or hypopharynx. No glands were palpable, so that the pressure can only have been due to the oedema.

From this it will be seen that caution is required in treatment of the cervical region, and it is inadvisable to give the maximum dose attainable. Jüngling, writing in *Strahlentherapie*, Vol. XV, No. 1, discusses late lesions after systematic irradiation of the larynx for cancer. He has some thirteen cases for consideration, and advises that the dose, in laryngeal lesions at all events, delivered at the site of the growth, shall certainly not exceed 100 per cent. U.S.D., and that treatment shall be at infrequent intervals. It is interesting to note that he finds oedema glottidis is not at all a likely danger immediately following treatment, but that the dangerous time, when there may be need of an urgent tracheotomy, is three to four weeks after treatment, when the reaction is at its height.

CURRENT LITERATURE.

Köhler's Disease of the Second Metatarsophalangeal Joint.—B. VALENTIN (*Fortschritte a. d. Geb. d. Roentgenstrahlen*, Vol. XXIX, Part 2, April 22nd, 1922, pp. 173-175).—Description of a case, similar to that described by Köhler in 1920, with abscess-like cavity containing a sequestrum at the head of the bone. Pathological examination negative. The author decides against tuberculosis, and suggests a similarity to Perthes' disease. Two illustrations.

Duodenal Stenosis Consequent upon Old Tubercular Peritonitis.—F. HOCHSTETTER (*Ibid.*, pp. 176-178).

The History of the Development of Apparatus for the Production of High Tension Electrical Currents for Working Roentgen Tubes.—F. ZACHER (*Ibid.*, pp. 179-193).—Mainly detailed description of improvements in the windings of the induction coil, their insulation, and methods of cooling for prolonged use.

The Supratrochlear Foramen of the Humerus.—H. R. SCHINZ (*Ibid.*, pp. 193-200).—Anatomical and radiological study of six cases of a connection between the olecranon and coronoid fossæ, which only appears after adolescence and is the result of osseous absorption. The author believes it to be relatively frequent and due to strong hyper-extension of the fore-arm. Nine skiagrams.

The Differential Diagnosis between Complete and Incomplete Diaphragmatic Hernia.—J. FREUD and E. HORNER (*Ibid.*, pp. 201-208).—A discussion of a case of right-sided diaphragmatic hernia, with a large opening containing the stomach and a large part of the colon, with displacement of the liver, confirmed by operation. The authors discuss a right-sided diaphragmatic rupture in which the curve of the diaphragm is seen above abdominal organs, such as the stomach and intestine, and doubts its existence.

A Cause of Error in the Radiography of the Upper Cervical Vertebrae through the Open Mouth.—F. DE QUERVAIN (*Ibid.*, pp. 209-211).—The author calls attention to the fact that air in the pharynx can give a clear area on the X-ray plate which may simulate a fracture of the odontoid process. He suggests using a film placed upon the cocainised posterior pharynx.

Apparent Fissures in the Bodies of the Vertebrae in the Adolescent.—O. HAHN (*Ibid.*, p. 211).—Describes certain median fissures in one or more of the vertebral bodies of adolescents, taken fore and aft or sideways, which a post-mortem in one case showed to be due to unusually large nutrient canals.

Note upon the Character of Roentgen Rays.—K. STAUNIG (*Ibid.*, pp. 212-215).

The author suggests the determination of the minimum wave-length utilised by means of a spectrometer, which will provide information as to the relative intensity of each wave-length used, when the knowledge of the intensity of current in the tube will provide a measure of the total intensity of the irradiation. He thus gives an absolute value of the irradiation by the wave-length and the number of milliamperes seconds.

A New Exploration Table.—LORENZ (*Ibid.*, pp. 216-217).—Utilising the Potter-Bucky diaphragm below the couch for screen examination of the alimentary canal. The stand can be put in the vertical position without altering the adjustment of tube and diaphragm.

Upon the Improvement of the Spectrometer Method of Measuring.—O. FRITZ (*Ibid.*, pp. 218-223).—Comparisons with different tubes by the method of Staunig mentioned above. The author considers that for each thickness of tissue there is a radiation, determined qualitatively by the wave-length and quantitatively by the milliamperes seconds, which gives the best radiographic result.

The Milliamperemeter as Measure of Intensity of Radiation.—O. FRITZ (*Ibid.*, pp. 223-228).—Investigations with various tubes based on the proportion between total intensity of current through the tube and the intensity of the radiation.

The Discharge through the Lilienfeld Tube.—O. FRITZ (*Ibid.*, pp. 228-230).—Modifications in work due to heating current.

Distribution of Energy in the Incandescent Spot.—O. FRITZ (*Ibid.*, pp. 230-232).

Homogeneity of Discharge in the Lilienfeld Tube.—O. FRITZ (*Ibid.*, pp. 230-236).

The Etiology of the "Cascade Stomach."—R. FEISSLY and A. FRIED (*Ibid.*, pp. 237-239).—Description of two observations of a cascade stomach which showed no lesion of the stomach or pylorus, but only an abnormal shortness of the gastro-hepatic ligament and of the transverse meso-colon. The authors review the different suggestions as to the cause of this condition, with reference to biloculation due to modification in the direction of the colon, and give a list of references.

NOTES AND ABSTRACTS.

A Fatal, Pernicious Aplastic Anæmia of a Roentgen Specialist.—KNUD FABER (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 110-115).—A specialist in radiology, who has worked with very hard Roentgen rays, succumbs under a pernicious aplastic anæmia. A similar kind of anæmia has been observed in the case of two more radiologists and of three other persons occupied with radium rays.

Investigations Regarding the Condition of the White Blood Corpuscles in Guinea-pigs and Rabbits Exposed to Irradiation with Visible Rays.—CARL SONNE (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 116-127).—By irradiation of white, shaved guinea-pigs and rabbits with visible, luminous rays, a perceptible effect on the condition of the white blood corpuscles results.

In guinea-pigs an immediate decrease in the number both of lymphocytes and poly-

nuclear leucocytes occurs, but this is more pronounced for the former. Later, when the irradiation has ceased, an increase in the number of lymphocytes occurs in the course of a few days, so that this number exceeds the normal for some time. Coincidentally the number of the polynuclear leucocytes seems to be, if anything, normal.

These changes correspond to those found by Murphy and Sturm with regard to the temporary influence of dry heat on rats, mice, and guinea-pigs.

In rabbits, 45 minutes after the irradiation, there is a very considerable increase in the number of the polynuclear leucocytes, simultaneously with a generally somewhat smaller decrease in the number of the lymphocytes, so that the normal, strongly pronounced lymphocytic form has in the course of 2—3 hours become leucocytic. Next day the form is again normal, so that it can once more be

affected in the same manner by a new light-bath.

Physical Facts of Roentgenological Importance.—AR VID ODENCRANTS (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 128-138).—A brief summary of the physical laws which are of importance for X-ray work is given. First the origin of the rays; then the continuous and characteristic spectra, the diffuse and fluorescent absorption, lastly the photographic and luminescent effects. In each case also the importance of the laws for practical work is pointed out—especially the necessity of exactly defining the working conditions in physical units.

The Roentgen Picture of Interlobular Exudates and Pleural Thickenings Especially with Regard to the Differential Diagnosis of Tuberculous Infiltrations in the Upper Right Lobe.—P. FLEMING-MÖLLER (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 139-154).—By X-ray examination one cannot, as most authors suppose, obtain an absolutely reliable basis for the diagnosis of an interlobular exudate. Of course, the exudate gives quite a characteristic picture, but tuberculous infiltration in the lower part of the upper lobe, which is commonly seen in roentgen examination of phthisical patients, as well as in cases of simple broncho-pneumonia, may give exactly the same picture.

The X-ray examination can only lead to a supposition that it is a question of interlobular exudate, but the diagnosis can only be made in connection with clinical observations, and a reliable result only obtained through a positive finding with an exploratory puncture.

A well-defined lower border of the shadow argues more in favour of an infiltration than of an exudate, whereas an upper well-defined border is rather in favour of an exudate, as processes of infiltration are not met with so frequently in the upper part of the middle lobe. When interlobular indurations of the pleura are seen, attention must be directed to the probability of an eventual tuberculosis of the lungs.

A "Radium Compensator" for Ionisation Measurements.—ROLF M. SIEVERT (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 156-165).—An instrument is described for rapid observations of the intensity of β and γ rays. The

apparatus is constructed primarily for medical use.

The ionisation current in a small chamber is compensated by means of another similar chamber, the latter together with a sensitive electrometer being placed in a lead box. The ionisation in the compensation chamber is produced by the β rays from a radium preparation, containing about 0.2 mgr. radium element. The compensation is brought about by increasing or decreasing the distance between the preparation and the last mentioned chamber until the electrometer thread remains in its zero position, irrespective of a switch for earthing being disconnected or not. The distance is read off on a micrometer.

Investigations of the possible sources of error show that the measurement of one intensity can be made in 20 seconds without a greater error than $\frac{1}{2}$ —2 per cent. depending upon the magnitude of the intensity.

Some Remarks on Os Trigonum.—CHR. J. BAASTRUP (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 166-175):—

1. After a fracture of the os trigonum one may see fragments joined to a large and plump bone projection, which may cause the patient great inconvenience owing to the plantar flexion being diminished on account of the mechanical disproportion.

2. Such large ossa trigona may also be congenital.

3. Effective assistance can be rendered only by operative removal of the process.

4. With fracture of the hindmost edge of the tibia, the posterior part of the astragalus ought also to be inspected, as this is possibly fractured at the same time, and conversely, with fracture of the os trigonum one should remember that the posterior edge of tibia may be broken.

Spondylitis Typhosa.—S. N. BAKKE (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 176-181).—The author describes a case of spondylitis typhosa, the clinical picture of which answers closely to the case described by Quinke as to the following cardinal symptoms: (1) The remarkably intense and diffuse local pains. (2) The acute course. (3) The rapid abating of the spinal pains, and (4) The noticeable swelling of the soft parts of the vertebral column. The skiagram is different from what

is seen in spondylitis tuberculosa. First of all there is no marked atrophy of lime salts and no destruction of the vertebral body. Coincidentally with the pathological process present in the body of the vertebra there is also a proliferating process, with a bridge-like connection between the second and third vertebrae. The articular space between these two vertebrae is reduced. After fully three months a more transparent portion (of the vertebrae) is seen on skiagrams in profile, a sequestrum (?) being discernible in that portion.

The process did not react to tuberculin injections.

The Operated Bladder as Seen on the Roentgen Picture.—FRIEDRICH KRAFT (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 182-186).—After operations on the bladder (with the exception of the endo-vesicular methods) typical changes are met with, viz. :—

1. Formation of the so-called "fore-bladder," better called "after-bladder," is very often brought about after prostatectomy owing to the insufficiency of the internal sphincter muscle.
2. Diverticulum operations lead to an asymmetrical bladder outline.
3. The changes after sectio alta are, from the X-ray standpoint, very difficult to demonstrate.
4. Incrustation of sutures may lead to a wrong diagnosis of calculus.

A Thermo-Needle with Inset Regulative Heating Apparatus, together with some Measurements of Cutaneous, Subcutaneous, and Intramuscular Heat Endurance.—CARL SONNE (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 187-193).—The author points out that, when employing a thermo-needle made from an ordinary steel cannula, the point of which can be heated to different temperatures by means of an electric resistance coil, a temperature can be endured several degrees higher beneath the skin than on its surface, without any sensation of pain being felt.

This corresponds to the fact that, when irradiating the surface of the skin with luminous or dark rays, a far greater volume of energy is absorbed in the case of irradiation with luminous rays (which for the most part

are absorbed deeper down) than by irradiation with dark rays, where the energy is absorbed on the surface.

Wooden Splints for Roentgen Use.—S. N. BAKKE (*Acta Radiologica*, Vol. II, Fasc. 2, pp. 194-195).—The author recommends that the part of the Volkmann splint in which the thigh and leg rest should be replaced by a corresponding part of wood. The same alteration is recommended in regard to the Zuppinger splint, in order that radiography may be carried out through the splint without this having to be removed, thereby facilitating the work of the radiologist and minimising the chance of pain to the patient.

Finsen's Medical Light Institute.—C. E. CHRISTENSEN (*Acta Radiologica*, Vol. II, Fasc. 3, pp. 210-242).—In 1894 Niels Finsen published his first observation of the fact that he had been able to prevent the development of disfiguring scars in the skin of patients suffering from small-pox—which is otherwise an inevitable result of that disease—simply by exclusion of the chemical rays of sunlight from the patients.

In 1895 he started his fundamental researches on the therapeutic effect of concentrated light upon lupus vulgaris. The excellent result of these attracted the keen interest of a number of prominent business men and doctors and inspired them to offer to establish and support a provisional laboratory for further researches.

In 1896 this resulted in the foundation of a permanent Institute for light-treatment under the name of *Finsen's Medicinske Lysinstitut*. The first permanent Institute was built inside the area of the Municipal Hospital of Copenhagen (Kommunehospitalet).

Under these circumstances Finsen was free to concentrate all his energy on the study of the treatment of lupus vulgaris by concentrated light applied directly upon the patches.

The result obtained by this treatment attracted the attention of many medical authorities in foreign countries. Consequently it became necessary to organise a regular manufacture and export of instruments for local light-treatment after Finsen's method.

In 1901 a large new institute was built in Rosenvænget to cope with the rapidly increasing number of patients.

At the same time Finsen was taking the preliminary steps to start a new series of researches on the effect of general light-baths upon a number of other diseases.

But Finsen's state of health had always been extremely delicate, and it was only shortly before his death (24th September, 1904) that he laid down in a detailed proposal his final ideas concerning the establishment of a sanatorium for the special study of the effect of the general light-bath upon the human organism and upon its different disorders.

This plan was carried out in 1906, a new clinic for internal diseases being opened that year in the month of May.

In 1913 Reyn started a series of researches on the treatment of surgical tuberculosis and of lupus vulgaris by general carbon-arc-light-baths.

The experiments were absolutely successful. In order to ascertain this fact through a sufficient number of experiments a special clinic for this treatment was built in 1916.

In November, 1921, a large new hospital for patients suffering from cutaneous or surgical tuberculosis was opened.

Roentgen Treatment of Primary Polycythemia.—FRODE RYDGAARD (*Acta Radiologica*, Vol. II, Fasc. 3, pp. 243-260).—Three observations upon patients with polycythemia are reported. One of these was cured by Roentgen treatment of the spleen, and the two others by treatment of spleen and bone marrow.

In some cases Roentgen treatment of the spleen alone gives favourable results, but in the majority of cases it has no effects on the polycythemia.

Vigorous Roentgen irradiation of the bones seems, so far as one can judge at present, to be an effective remedy for this condition.

The main features in the technique of the treatment are indicated in this paper.

The Radiography of Os Petrosum.—L. G. HEILBRON (*Acta Radiologica*, Vol. II, Fasc. 3, pp. 261-263).—Stenvers, after exact anatomical study of the os petrosum, developed a method of radiographing the labyrinth, etc., but his method of obtaining, and fixing the patient in, a good position is very difficult, while his way of getting a suitable landmark is also very troublesome. Therefore the author had an apparatus made by the A. E. G.,

on which the patient lies very comfortably. It is only necessary to centre the tube above the landmark and the exposure can be made.

Two Unusual Cases of Multiple Ureteral Calculi.—KAI WEGGE (*Acta Radiologica*, Vol. II, Fasc. 3, pp. 264-267).—The author describes two cases of multiple ureteral calculi. In both cases there is a considerable number of stones, but one of them presents a very unusual picture, inasmuch as one of the ureters is closely packed with stones from the pelvis of the kidney right down to the bladder.

Secondary Rays in Radium Therapeutics.—ROLF M. SIEVERT (*Acta Radiologica*, Vol. II, Fasc. 3, pp. 268-300).—The physical facts which seem to be of interest when studying the problem of secondary radiation in radium therapeutics have been stated.

Some mathematical laws with regard to secondary radiation have been fixed in order to give a general view of the distribution of this radiation.

By means of an instrument previously described in this journal, investigations have been made with regard to:—

1. The secondary radiations from screens of different materials and thicknesses placed in various positions between a radio-active substance and the ionisation chamber.
2. The secondary radiation measured with different kinds of ionisation chambers.
3. Secondary radiation from water volumes in different positions.

The results of the measurements in No. 1 seem to agree with those of other investigators.

Lastly, some questions have been briefly treated which may be of interest in radium therapeutics, the following facts being emphasised:—

1. The wall of the ionisation chamber should be comparatively thick (for ex. 2-5 mm. ivory) when investigating the distribution of intensity.
2. Secondary radiation is of practically no importance when emitted from tissue outside a sphere with a radius = the distance between the

- applicator and the part exposed, and
with its centre just between these
two.
3. When treating at a distance the

secondary filter should be placed just
between the applicator and the skin,
thereby giving a minimum of second-
ary β radiation.

EXPOSURE TABLES FOR COOLIDGE TUBES.

MESSRS. WATSON & SONS (ELECTRO-MEDICAL) LTD., have issued an Exposure Table for Coolidge X-ray Tubes in card form for distribution amongst those interested in X-ray technique, including radiologists, doctors and electrical engineers.

Exposures are given, on the one side, for double coated films and on the other, for X-ray plates.

This is an attempt as far as possible to standardise technique in order that results obtained may be made comparative.

The exposures are based on a subject of average weight, and any considerable variation will necessitate a slight increase or decrease of the exposures given.

These cards when damaged or worn will be replaced.

IMPORTANT NOTICE.

THE ARCHIVES will appear in the first issue of the New Year in another form and with a change of name.

This is the outcome of negotiations between the Röntgen Society and the Council of the B.A.R.P. regarding an amalgamation of the respective Journals. The Editor has pleasure in announcing that from January, 1924, the ARCHIVES will assume the name of THE BRITISH JOURNAL OF RADIOLOGY (formerly the *Archives of Radiology and Electrotherapy*).

"The Journal of the Röntgen Society" will in like manner become the BRITISH JOURNAL OF RADIOLOGY, RÖNTGEN SOCIETY SECTION.

The two Journals will be published separately, each maintaining its individuality. The ARCHIVES will be altered in size of page, type, etc., to conform with that of "The Journal of the Röntgen Society." There will be a close collaboration by the Editorial staff of both Journals.

It is hoped that this step will ultimately lead to complete amalgamation.

PUBLICATIONS RECEIVED.

Books.

Diathermy and its Application to Pneumonia. By H. E. STEWART, M.D. \$3.00 net. (Paul B. Hoeber, New York.)

La Chronaxie chez l'Homme. By Dr. GEORGES BOURGUIGNON. (Masson, Paris.)

Journals.

L'Actinoterapia, November 30th, 1923.

Archives d'Electricité Médicale et de Physiothérapie, November, 1923.

Archivio Italiano di Chirurgia, November, 1923. Parts 2 and 3.

Bulletin et Memoires de la Société de Radiologie Médicale de France, November, 1923.

Bulletin Officiel de la Société Française d'Electrothérapie et de Radiologie, October, 1923.

Journal of Bone and Joint Surgery, October, 1923.

Journal of Laryngology and Otology, December, 1923.

Journal de Médecine de Bordeaux, November 25th, 1923.

Journals—continued.

Journal de Médecine de Lyon, November 20th; December 5th, 1923.

Journal de Radiologie et d'Electrologie, November, 1923.

Journal of Radiology, November, 1923.

Kongresszentralblatt für die Gesamte Innere Medizin und ihre Grenzgebiete, November 12th, 19th, 26th; December 3rd, 10th, 1923.

Medical Journal of Australia, October 20th, 27th, 1923.

Medical Science: Abstracts and Review, December, 1923.

New York Medical Journal and Medical Record, November 21st, 1923.

New York State Journal of Medicine, November, 1923.

Norsk Magazin for Lægevidenskaben, December, 1923.

Il Policlinico, November 15th, 1923,

La Radiologia Medica, November, 1923.

Strahlentherapie, Bd. XVI, Heft 1, 1923.

Ugeskrift for Læger, November 22nd, 29th, 1923.

Urologic and Cutaneous Review, November, 1923.

NOTICES.

ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY is published monthly.

The index for each volume, which ends with the May number, is supplied with the June number of each year.

All communications should be addressed to the "Editorial Secretary of ARCHIVES, c/o WM. HEINEMANN (Medical Books) Ltd., 20, Bedford Street, London, W.C. 2."

Communications and illustrations from American contributors may be sent to Messrs. REBMAN COMPANY, 59, West Fifty-first Street, New York City.

All skiagrams and photographs must be originals, and must not have been previously published. Drawings should be supplied on separate paper. MSS. should be carefully revised, since alterations and corrections in type are undesirable and costly.

No free reprints will be given. If needed reprints may be obtained on payment, but notice must be given when proof is returned.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

THE OFFICIAL ORGAN OF THE
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RADIOLOGY AND PHYSIOTHERAPY

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X-RAY AND CLINICAL FINDINGS IN NORMAL CHEST OF CHILDREN, SIX TO TEN YEARS.

NATIONAL TUBERCULOSIS ASSOCIATION MEDICAL RESEARCH.

THE National Tuberculosis Association some time ago began a new and important phase of its work in an attempt to increase the quantity and character of research work in problems related to its own field in the United States. For this purpose it appropriated \$20,000 and appointed a small committee, composed of Dr. Wm. Charles White, Medical Director of the Tuberculosis League of Pittsburgh, Dr. Paul A. Lewis, Director of Laboratories of the Phipps Institute, Philadelphia, and Dr. Allen K. Krause, Director of Kenneth Dows Research Fund, Johns Hopkins Hospital, to expend these funds to the greatest advantage.

This committee decided that the best use of these funds would be in assisting researches already under way that held the greatest promise of increasing the practical knowledge of physicians dealing with tuberculosis. This, they considered, would bring the greatest help to those suffering from tuberculosis, and the greatest boon to the public from whom the funds were collected. This plan has been carried out in co-operation with the universities.

One of the researches was an effort to establish the X-ray and clinical findings in the chest of a normal child up to ten years of age. For this problem the National Tuberculosis Association nominated the following groups of roentgenologists and clinicians:—

Dr. H. K. PANCOAST and Dr. H. R. M. LANDIS (University of Pennsylvania).

Dr. F. H. BAETJER and Dr. C. R. AUSTRIAN (University of Johns Hopkins).

Dr. H. K. DUNHAM and Dr. K. D. BLACKFAN (University of Cincinnati).

The signed reports of these physicians is here presented in two sections, with the hope that they may promote a discussion which will be fruitful in establishing the truth in these two fields.

THE X-RAY AND CLINICAL FINDINGS IN THE NORMAL CHEST OF THE CHILD.
*Report of the Clinical Division of the Committee on Medical Research of the
National Tuberculosis Association.*

The value of roentgenography in determining the presence of pulmonary disease has long been recognised. Studies to determine the roentgenograms of various pathological lesions of the lung have been almost without number, yet much difference of opinion exists in the interpretation of findings, largely because no satisfactory observations have been made establishing the variations that may occur in the normal. To one observer shadows noted are indicative of disease; to another they are not evidence of a pathological process; to one they represent lesions of clinical significance; to another they suggest changes of no moment. The realisation of this unsatisfactory state of affairs was widespread, but it remained for the Research Committee of the National Tuberculosis Association seriously to consider it and to set about to correct the shortcomings.

In the spring of 1920 that Committee called together the collaborators in this work and instructed them to set about in ways of their own choosing to solve the problem, extended to them a financial grant, and in order that the problem might be a very definite one, asked that the immediate study be limited to a consideration of the chests of normal children between the ages of six and ten years. The work was begun promptly, and a preliminary report was made at the annual meeting of the Association in May, 1921. The findings at that time were incomplete, and because of the then limited observations no very definite conclusions were drawn. However, the practical need of a solution of the problem was apparent. Study was continued throughout 1921 and the first four months of 1922, and the data independently assembled were jointly discussed to evaluate them. Although each pair of workers carried on its investigations without inter-group consultation, although each approached the subject from a different angle, and when first met held views

apparently not altogether in accord, it was agreeable to find that an exchange of conclusions disclosed almost an unanimity of opinion. The findings of these six observers—three clinicians and three roentgenologists—are presented to you for your consideration:—

Theoretically, the normal child is one of ideal height, weight and development for his age, without subjective or objective evidences of deformity or of disease, and without residual changes due to antecedent pathological processes. Practically, a normal child is one of average height, weight and development for his age, symptom-free and without signs of disease. Each such individual, in more or less relation to his age, will have been ill more or less often, and as a consequence may be expected to show variations from the ideal, not because of present disease, but as a result of residual changes that persist. An appreciation of these facts makes it apparent that the findings, clinical and roentgenographic, in normal children as we meet them will vary greatly from any fixed standards and still must be considered as variants of normal.

The clinical data dealt with in this report were obtained by careful examination of apparently healthy children between the ages of six and ten years. All children who showed signs of disease were excluded from the series. Individuals from various strata of society, foreign and native born, residents of urban and of rural communities, school children and children residing in institutions, children exposed to tuberculosis and some without a history of such exposure, children with and without a history of previous infectious diseases, all symptom-free, and of an approximately normal height and weight for their ages, were studied. A history of each individual was recorded, and in making the examinations of the chest care was always observed to have the child relaxed and to see that no cramped or unnatural posture was assumed, for, as is well known, faulty position may lead to findings that cause confusion in interpretation. In addition, a tuberculin test was made on every child. The clinical data were then assembled, and after the roentgenologist had interpreted his plate independently the clinical and roentgenographic findings were correlated.

In all over 500 children were thus studied, and as a result some very definite conclusions seem warranted.

As in the adult, so in the child vocal fremitus is more marked over the right upper chest than over the left.

It is generally stated that the percussion note elicited over the lungs of normal children within the age limits under consideration is fuller, more tympanitic, of higher pitch and more resilient than that noted over those of adults, and that frequently the tympanitic quality is quite outspoken, especially over the lower lobe of the left lung. Although in general our observations confirmed this view, we have been impressed by the fact that in an appreciable number of such children the note obtained on percussion over the lungs is indistinguishable in quality from that elicited over the lungs of normal adults, and that the usual resilience of the note is lacking. These findings in many instances have an analogue in shadows noted in the X-ray films, shadows

indicative of increased density along the bronchial tree, similar to those seen in the plates of normal adults. This correlation of the findings on physical examination and on X-ray study is more constantly possible in studies of the upper half of the chest. When minor changes, similar to those discovered by X-ray examination of the upper lobes, occur in the bases, they usually escape detection on physical examination. In those instances in which no shadow is found to explain the deviation of the note from the generally accepted one, it is our belief that the lack of resilient quality may be due to a decreased elasticity of the chest wall.

The so-called tympanic quality of the percussion note over the left base may be increased, decreased, or be entirely lacking, depending upon the degree of distension of the stomach or colon, the curvature of the spine, and may likewise vary with the position of the diaphragm or with the posture of the child during the examination. The note over the upper thorax is often the same on the two sides. Kronig's isthmus averages 5 to 6.5 cm. in width. The lower margins of the lungs posteriorly are at the level of the tenth or eleventh rib and descend from 1.5 to 3.5 cm. during forced inspiration.

A just detectable diminution of resonance over the apical regions is of no significance unless associated with a modification of the breath sounds in those areas or with other abnormal auscultatory findings.

It is generally accepted that normally in childhood the breath sounds have a harsh, sharp character, with expiration longer and better heard than in the normal adult. This so-called puerile breathing is physiological, and though it may seem trite, let it be emphasised that this exaggerated vesiculo-bronchial respiratory murmur, especially well heard in the areas overlying the great bronchi (*i.e.*, anteriorly at the level of the first interspace and the second rib just lateral from the sternal margins, and posteriorly, particularly on the right side, at the level of the second to the fourth spine) is often incorrectly interpreted as evidence of pulmonary disease. An auscultatory finding that has not been pointed out, or at least has not been emphasised, has come forcibly to our attention in carrying out this study. Just as the full, deep note or higher pitch characteristically elicited by percussion of the child's chest is often replaced in health by a note more like that produced when one percusses the normal chest of an adult, so on auscultation of a child's normal lungs the exaggerated or puerile breath sounds may be lacking, and instead the so-called vesicular respiratory murmur characteristically present in adult life is heard. This finding, regarded by us as a physiological variation, has been noted as early as the age of four years, and may perhaps occur in younger children. It is more readily appreciated and more often found than the variation in the percussion note just described. In more than 50 per cent. of the children in which this type of breathing was heard, examination with the X-ray gave findings like those obtained by a study of normal adult chests. In fact, the agreement of clinician and roentgenologist was so constant that we have come on the basis of these variations to designate the chest of normal children as of "puerile" or of "adult" type. The essential fact to be stressed is that so

called vesicular respiration is heard with great frequency in normal children, and is to be regarded as a variation of normal and not necessarily as an indication of disease.

These variations and those of the percussion note are more generally found in children with a history of infections of the respiratory tract. No satisfactory explanation for this finding is offered. It may be due in part to altered resilience of the chest wall, a suggestion supported by the fact that in some instances in which it was noted diminished elasticity of the thoracic wall was apparent on percussion. It may stand in relation to variations of elasticity of the parenchyma of the lung. It may be due to a relative narrowing of the lumen of the bronchial tree. It is hardly to be considered evidence of increased density of respiratory tissue, for, theoretically at least, that should lead to a modification towards bronchial breathing.

Concerning the whispered voice sounds, little comment needs to be made other than to emphasise their loud transmission often with sibilant sounds over the region of the major bronchi. Auscultation of these sounds over the upper thoracic spine of the children has led to the conclusion that D'Espine's sign as indicative of enlarged tracheo-bronchial lymph nodes is, to say the least, of doubtful value. In twenty-three of the children this sign was elicited without other signs of a mediastinal mass and without any corroborative evidence on X-ray examination. In three the sign could not be elicited, although from the X-ray plate it might have been inferred that it should be. Eustace-Smith's sign is so generally present in normal children that it is of little or no practical diagnostic worth. The presence of these two signs, together with impairment of resonance in the interscapular region, is all too frequently made the premises for a diagnosis of tuberculosis of the tracheo-bronchial lymph nodes. This is unwarranted, for, as indicated, these signs are unreliable evidence of a pathological condition, and the determination of a diminution of resonance in the interscapular region requires such a nicety of technique that even masters of percussion disagree as to the presence or absence of significant findings in this region of the chest.

A year ago, in the preliminary communication to this society, we stressed the importance of the rôle that antecedent infections might play in the production of areas of increased density within the respiratory tract. (Bronchial tree, parenchyma of the lungs, etc.) This fact is re-emphasised, for further study has established the importance of it. Not only may recognised or remembered infections of the bronchi and lungs be responsible for alteration in these tissues, but other diseases not ordinarily considered of significance in this regard may be causal of such changes. For example, our observations indicate that after measles, pertussis or tonsillar infections, areas of increased density, radiating from the hilum into the bases especially, occur with great frequency. Such lesions generally are not discoverable on physical examination and would be unsuspected but for the use of the X-ray. They are referred to in the clinical part of our joint report in order to point out the need of a careful history as well as examination in all individuals, before proceeding

finally to interpret the findings of the roentgenologist. By way of digression, it may be interesting to point out the fact that though measles and pertussis have been known to produce lesions in the upper air passages, involvement of the lower tract has been considered a complication, and was thought to occur only when evidences of bronchitis or of broncho-pneumonia were discovered. Our observations indicate that there may be a mild inflammatory process throughout the respiratory passages in a large percentage of the so-called uncomplicated cases of these diseases. This suggestion warrants further study in relation not only to the infections under consideration but also other infectious diseases. That such shadows, mediastinal and basal, noted in children who give a history of uncomplicated measles and pertussis are evidences of healed processes, is evidenced by the experience that similar shadows of like origin have remained unchanged and without the development of clinical symptoms in a series of children observed from three to five years. Such changes must be properly evaluated as indices, not of present disease, but of lesions past and healed; not as warrants for the diagnosis of present illness and the institution of treatment, but as scars of infections met and overcome.

Most of the children included in this study were tested with tuberculin—some were given a cutaneous test with old tuberculin (P), others were tested by the intracutaneous method. (Craig.)

The foregoing facts have been detailed at some length to establish the major thesis that, clinically, the ideal, normal child is a hypothetical impossibility. Children, apparently healthy, symptom-free and active, show on careful examination many deviations from findings, and variations that must be interpreted as within physiological limits of height and weight must be elastic; measures of resonance and of resilience of the chest must not be rigid, and estimates of acoustic phenomena must permit of a range of difference from the ideal. These facts, clinical experience establishes beyond peradventure, and they suggest a corollary, namely, that X-ray examination of the chest of such children may be expected to show comparable deviations from a fixed ideal roentgenogram.

The studies reported, fortified by past experience, warrant the following conclusions:—

1. The data obtained on percussion and auscultation of the lungs of normal children show wide variations from a fixed standard. These variations are usual and are considered to be within normal limits.
2. Inasmuch as the changes referred to are dependent often upon alterations that persist as the residua of past infections of the respiratory tract, it is obvious that a careful history, with special reference to all infections, is necessary if diagnostic errors are to be avoided. Even a history carefully taken is often unreliable, as minimal infections are soon forgotten by many, and among the unintelligent classes even more significant indispositions are not readily recalled.

3. Failure properly to evaluate these deviations from a fixed standard will often lead to the unwarranted diagnosis of disease and to even less justifiable treatment.
4. With a proper appreciation of the widest variations that the normal may present from the ideal, the informed clinician is better able correctly to understand the findings of the roentgenologist, and each, co-operating with the other, is less liable to error.
5. D'Espine's sign as indicative of enlarged tracheo-bronchial lymph nodes is of little value.
6. Recognition of and familiarity with the foregoing data is of cardinal and practical importance to every patient, potential and established. Without a proper appreciation of the facts set forth, no intelligent differentiation between a normal and an abnormal respiratory tract can be made.

In brief, to establish the presence or absence of disease, it is imperative that all data—clinical, laboratory and roentgenographic—must be evaluated and correlated, and that no one fraction of the evidence be stressed to the exclusion of the others.

(Signed)

C. R. AUSTRIAN.

H. R. M. LANDIS.

KENNETH D. BLACKFAN.

May 6th, 1922.

THE X-RAY AND CLINICAL FINDINGS IN THE NORMAL CHEST OF THE CHILD.
*Report of the X-Ray Division of the Committee on Medical Research of the
National Tuberculosis Association.*

It is generally conceded that one of the most important factors in accurate interpretation of the appearance of morbid processes in the roentgenogram of the thorax is a thorough familiarity with the normal and variations therefrom within normal limits. With a full realisation of this in view, the National Tuberculosis Association, in 1920, appointed a committee, comprising three roentgenologists and three internists, to make a study of the normal chest of the child between the ages of six and ten years. This group was instructed to work in co-operation and to make a report of their investigations before the Association when their studies were completed and their conclusions reached. The members selected for the committee were Dr. H. Kennon Dunham, of Cincinnati, Dr. Frederick H. Baetjer, of Baltimore, and Dr. Henry K. Pancoast, of Philadelphia, to act in the capacity of roentgenologists and to work in co-operation with the respective internists in the same cities, Dr. Kenneth Blackfan, Dr. Charles R. Austrian and Dr. H. R. M. Landis. Each group of two was to work independently until a satisfactory number of individuals were examined, and the entire committee was then to meet and draw their conclusions for presentation. It was to be the duty of the internist in each group,

by careful clinical study, to select as nearly normal children as possible for examination by the roentgenologist. The entire procedure was to be carried out with strict co-operation between the two members of each group.

It was soon realised by the X-ray members of the groups that an attempt to describe a normal chest was practically impossible. Their endeavours soon began to centre around the description of a theoretical normal with wide variations, that would serve as a basis for the interpretation of abnormal appearances and tend to preclude the possibility of erroneous diagnoses being based upon faulty interpretations of hilum shadows, trunk shadows, and linear markings more or less altered in appearance by the frequent respiratory infections of children. They realised that herein had existed the greatest source of error in interpretation, and no doubt the Association had this same thought in mind when the committee was appointed to take up these investigations. Errors in interpretation have been made chiefly in connection with the diagnosis of pulmonary tuberculosis.

It was the consensus of opinion that children are probably more apt to show definite X-ray evidences in the hilum and trunk shadows of simple as well as serious respiratory infections than adults. Practically all children of the ages of those examined have had at one time or another one or more respiratory infections, especially measles and whooping cough, that are likely to produce very apparent changes in the shadows mentioned, and which will remain distinctly visible for a variable period of time. These apparent deviations from the normal are not necessarily abnormal when observed, but may be the harmless results of one or more infections. No doubt such appearances have many times been misinterpreted as evidences of tuberculosis. In the conclusions reached by the committee the attempt has been made to preclude this possibility.

Many of the general observations may not have been included in the conclusions. One of these perhaps worth mentioning is the fact that the heart of the child is found to extend relatively further to the right than in the adult.

The thoroughness with which the studies were carried out may be in part realised from the number of individuals examined. Over five hundred children were selected from all strata of life, as stated in the clinical report of the committee.

The groups comprising the committee met at the Phipps Institute, Philadelphia, March 3rd, 1922. Prior to this meeting there were misgivings as to the possibility of an agreement upon any very definite conclusions, but much to the satisfaction of all the members a definite agreement was reached and the conclusions were completed after a few hours careful deliberation.

To assist in a better understanding of the conclusions of the committee, a composite diagrammatic reproduction of several roentgenograms was made. It must be remembered that the three zones like the chest have thickness as well as length and breadth. Thus, the zones extend anteriorly and posteriorly from the lung root as well as laterally.

CONCLUSIONS OF THE X-RAY DIVISION OF THE COMMITTEE.

The Normal Chest.—The normal chest of the child, from the roentgenologic standpoint, is subject to such wide variations within normal limits as to be beyond the possibility of exact description.

Hilum Shadow.—The conglomerate shadow, commonly called the hilum shadow, when found lying entirely within the inner third or zone of the lung area, can be disregarded (or regarded as normal), except where it is made up of a solid mass of homogeneous shadow giving undoubted evidence that it represents a growth or mediastinal pleurisy.

Calcified Nodes.—Calcified nodes at the root of the lung, without evidence of lung disease, are of no significance except as a possible evidence of some healed inflammatory condition, possibly but not necessarily tuberculous. They are a common finding in normal chests.

Density and Thickness of Trunk Shadows.—In the normal lung the bronchial trunk shadows are not visible in the extreme apical regions. For convenience of description, the remainder of the lung is divided into three vertical zones, extending outward from the lateral border of the spinal shadow to the lateral chest border.

The inner zone contains the root shadows.

The mid zone contains the trunk shadows, gradually fading out into their final subdivisions.

The peripheral zone contains radiating lines from these and fading off before the periphery is reached.

Where, in the mid zone or peripheral zone, these shadows do not disappear in the characteristic fashion described, the appearance may be evidence of a variety of conditions, past or present, of an inflammatory nature or otherwise. It may accompany a tuberculous process but it is not necessarily indicative of tuberculosis.

Improper or Misleading Terms.—The use of the term "peribronchial tuberculosis" and "parenchyma tuberculosis" is not to be recommended in the interpretation of roentgenograms of the chest. Until corroborated by laboratory or clinical findings, the use of the terms "active" and "quiescent" should not be definitely applied to evident lesions demonstrated on plates.

(Signed)

HENRY K. PANCOAST.

KENNON DUNHAM.

F. H. BAETJER.

May 6th, 1922.

BARIUM PLASTER WALLS FOR X-RAY TREATMENT CUBICLES.

By A. E. BARCLAY, M.A., M.D. (Cantab), D.M.R.E. (Cantab).

So many enquiries have come through as to the barium plaster which we have employed instead of lead for making X-ray-proof cubicles in the new department in this hospital, that I thought it would be worth sending a note of the composition of the plaster, which we arrived at by various experiments. I believe the idea emanated from America, but to whom the credit is due I do not know.

Composition.

1. Commercial barium sulphate, 1 part by bulk.
2. Portland cement, " "
3. Sharp well washed sand, " "

Mix 1 and 2 thoroughly when dry, and then add the sand and turn over thoroughly three times when dry and three times after the water has been added.

Apply the coat of plaster half an inch thick and "rough render." The second coat can be three-eighths of an inch thick or more, which is trowelled off and finished with Keene's, or Parian, cement. The finished coat comes to seven-eighths of an inch thick, and tested with radium is equivalent to 3.5 mm., and a maximum of 4.5 mm. of lead. The plaster has been applied on both sides of the partitions, and the radium test gave an average of 8.5 mm. of lead.

It is inadvisable to plaster on to wood owing to the shrinkage. Our partitions are made of Jabez Thompson's wood-brick, which is light, practically sound- and fire-proof, and makes an excellent key for the plaster.

As to the cost—commercial barium is less than half the cost of lead per ton, and, of course, there is no difficulty in applying. It seems to make an extremely satisfactory job.

I am indebted to Dr. Arthur Burrows, of the Manchester Radium Institute, for testing the walls, and to Mr. C. R. Fryer, Clerk of the Works, Manchester Royal Infirmary, for the experimental work, and he will be pleased to answer any enquiries.

A HITHERTO UNDESCRIBED BONE IN THE TARSUS.

By PERCIVAL D. CAMERON, M.D., Radiologist to the Dunedin Hospital, N.Z.

THIS bone was found in the foot of a male, æt. 24. It had been present from birth and formed a distinct projection on the inner side of the foot, lying in the angle between the scaphoid and internal cuneiform bones. In the same foot there was a quite definite tibiale externum lying in close contact with the head of the astragalus, between the scaphoid and the sustentaculum tali. Neither of the extra bones was present in the foot of the opposite side.

The radiological appearances suggest that the undescribed bone is con-

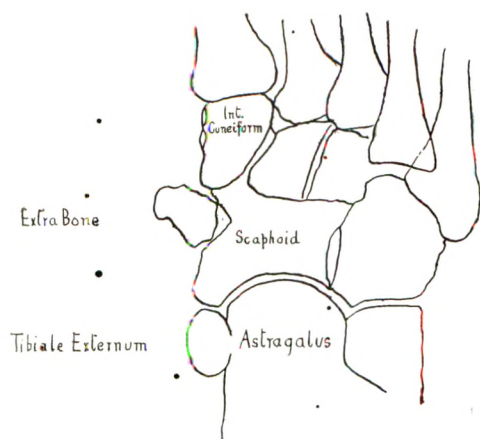


FIG. 1.

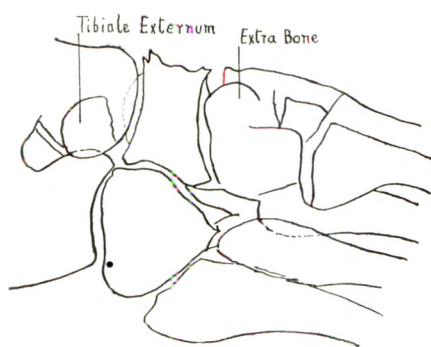


FIG. 2.



Left foot,



Left foot.

nected more particularly with the scaphoid, and apparently distinct articular facets are present at their junction.

The X-ray plates were referred to Professor Gowland, of the Otago University, to whom I am indebted for the following remarks and for most of the references :—

“Extra bones in the carpus and tarsus have attracted a considerable amount of attention of late. A bone of this kind, which would seem to belong to the tarsal scaphoid, and which does not appear to have been previously described, is then of particular interest.

“The tarsal scaphoid is usually said to consist of a body—corresponding to the os centrale of lower vertebrates—and a tuberosity, the morphology of which is uncertain. Manners Smith considers that the tuberosity may consist of three elements :—

“1. An apophysial element, which is merely an outgrowth from the body.

“2. An epiphyseal element, corresponding to the naviculare secundarium of Gruber.

“3. A sesamoid element, developed in the tendon of the tibialis posticus, producing the tuberosity proximally, and probably corresponding to the tibiale externum of Pfitzner.

“May it not be the case that the new bone described in this paper is the apophysial element of Manners Smith? A possible alternative explanation is that it represents the os paracuneiforme of Dwight, concerning which I am unable to obtain information.

“The occurrence of separate ossicles belonging to the scaphoid is not supported by the mode of ossification usually described, *i.e.*, from a single centre about the fourth or fifth year. According to Hasselwander, however, the ossification may begin at two or more points, which soon coalesce, and V. Bardeleben describes two primary centres—one occurring later than the other—followed at puberty by an epiphyseal centre.”

REFERENCES.

- (1) Bryce, “Quain's Anatomy,” 11th ed., Vol. IV, Pt. 1.
- (2) Bizarro, *J. Anat.*, London, LV, p. 256.
- (3) Dwight, “Variations of the Bones of the Hand and Foot,” Philadelphia, 1907.
- (4) Forster, *Archives d'Anatomie, d'Histologie et d'Embryologie*, Strasbourg, Tome I, p. 3.
- (5) Thurstan Holland, *J. Anat.*, London, LV, p. 235.
- (6) Hasselwander, *Anat. Anzeig.*, XXXII, p. 608.
- (7) Howard Pirie, “Extra Bones in Wrist and Ankle found by X rays,” *Amer. J. of Roentgenology*, VIII, p. 599.
- (8) Manners Smith, *J. Anat. and Physiol.*, XLI, p. 255.

A SEPARATE CENTRE OF OSSIFICATION FOR THE TIP OF THE INTERNAL MALLEOLUS.

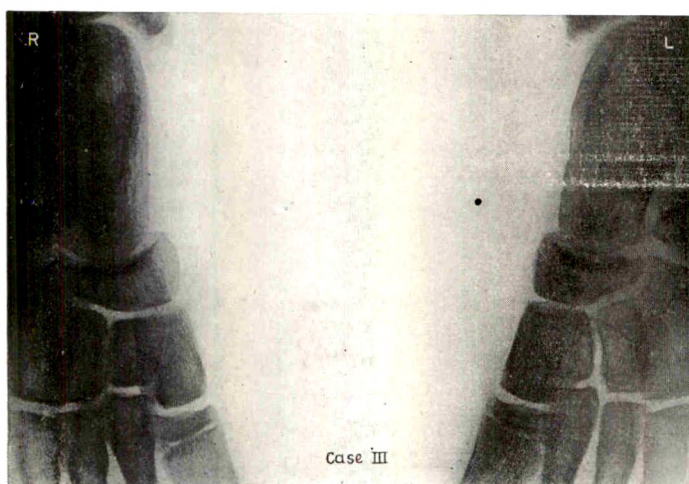
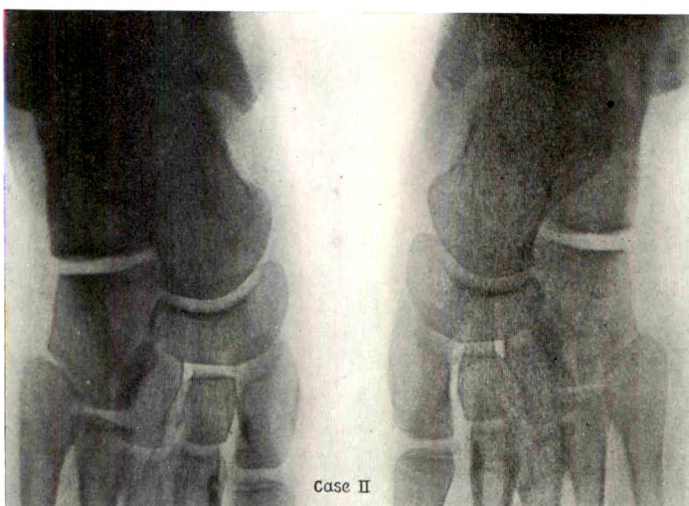
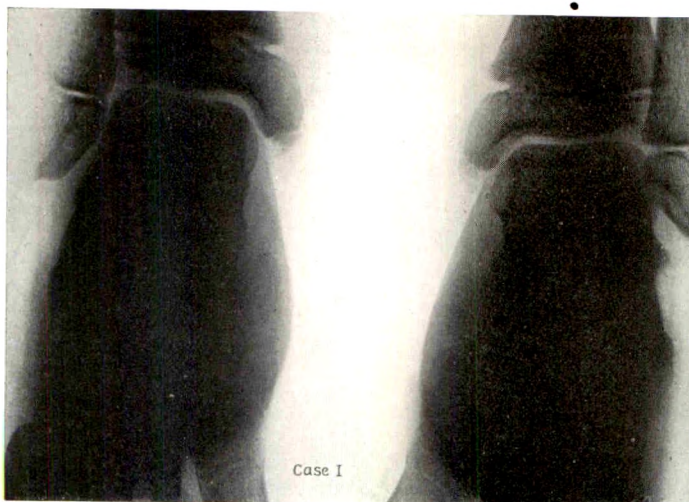
By H. A. T. FAIRBANK, M.S., F.R.C.S.

THE condition indicated in the title of this brief communication seems to be one of extreme rarity. It is certainly unknown to several radiologists of great experience. Sir Arthur Keith, who kindly examined the radiograms of the cases reported below, admitted that he had never met with a case; he allows me to add that he is unable to offer any morphological explanation of the condition. In Gray's "Anatomy" it is referred to as occurring "occasionally," while Cunningham says, "Lamberty notes the occasional presence of an accessory nucleus in the malleolus" of the tibia. Several text books of anatomy make no mention of the condition. Poland, in his work on "Traumatic Separation of Epiphyses" (p. 825), writes: "Béclard has once seen and described a special centre for the internal malleolus," but he (Poland) had never seen one.

The above facts make it all the more extraordinary that the writer should have come across three instances of this unusual ossification, and these within a period of three months. It is possible that when met with, the separate ossific centre has been regarded as a sesamoid bone, while sometimes, perhaps, a fracture has been diagnosed. We have no knowledge as to whether this separate piece fuses with the rest of the epiphysis or not, though it is highly probable that it does. If it does not invariably do so, the medico-legal importance of the condition is much increased.

Further information is required as to the frequency with which the separate ossicles occasionally found in the feet fuse with an adjacent bone. Some certainly do; others, as a rule, do not, while yet others may or may not fuse with another bone. With regard to the os tibiale externum, for instance, there seems to be uncertainty as to its fate. The general radiographic appearance of this ossicle, as to shape and relation to its parent bone (navicular), is very similar to that seen in the radiograms accompanying this article. The majority of the cases met with have certainly been in children, but that this piece of bone may remain separate throughout adult life is an undoubted fact. We have radiograms of a man of about 50 with very large tubercles of the naviculars in both feet. On one side the tubercle is separate from the rest of the navicular, while on the other the tubercle is continuous with the rest of the bone. The outlines of the two bones are so alike that one is tempted to say that an os tibiale externum had existed on both sides but had remained separate only on one.

To return to the three instances of abnormal ossification of the internal malleolus: in each case the patient was a girl; all were seen about the age of ten years; in each the condition was bilateral. In one symptoms referable to the malleolus followed a kick on the ankle. In two the radiograms were taken to show the foot rather than the ankle, but, even so, there can be no



doubt as to the presence of a separate centre of ossification for the tip of the internal malleolus on both sides. In two there is some difference in the size of the ossific nucleus on the two sides.

All who have kindly examined the radiograms agree that a diagnosis of sesamoids is out of the question in these cases.

Two of the cases complained of pain, tenderness and swelling in the region of the tip of the internal malleolus on one side only. These local signs rapidly disappeared with rest. It is extremely improbable that the signs had any connection whatever with the presence of an abnormal centre of ossification. They were regarded as evidence of a mild teno-synovitis in the sheath of the tibialis posticus tendon.

The writer is greatly indebted to Dr. Bertram Shires, who took the radiograms of the first case, for much information and assistance. Brief notes of the cases are appended :—

Case 1.—D. G., girl, 10 years. Seen at the Hospital for Sick Children, Great Ormond Street, in February, 1922, complaining of pain in the right ankle, dating from a kick by another girl five months previously. Flat feet. Puffiness and tenderness below R. internal malleolus. Plaster cast in inversion for six weeks, when all local signs had disappeared. Special boots ordered. No return of symptoms since. X-ray, taken by Dr. Shires, shows separate centres of ossification for the internal malleoli.

Case 2.—Miss J. O., aged 10 years; sent to me by Dr. Jeffreys, of Southampton, in March, 1922, complaining of pain in ankles during last two weeks. Pain had been severe enough to make her cry. Severe flat-foot with great prominence of the navicular bones in both feet. R. foot: tenderness just behind navicular tubercle. L. foot: tenderness behind, below and in front of internal malleolus. Contracture of calf with equinus on both sides. X-ray: separate centre for tip of internal malleolus in each leg. Treated by tendon slide of tendo Achilles, wrenching and plaster casts on both sides. Tenderness in R. foot disappeared with a few days rest before operation, while tenderness of L. ankle had disappeared after the foot had been a month in plaster.

Case 3.—Miss R. M. W., aged 10½ years, a patient of Dr. Andrew, of Exeter, was seen in April, 1922, complaining of L. ankle going over. No pain. Spasmodic flat-foot both sides. No tenderness of ankles. X-ray: separate centres of ossification both internal malleoli. The oval dense spot seen in the astragalus is actually in the substance of that bone.

FIBROCYSTIC DISEASE OF THE UPPER END OF THE HUMERUS.

By C. P. G. WAKELEY, F.R.C.S. (Eng.), Assistant Surgeon and Teacher of Clinical Surgery, King's College Hospital, London.

FIBROCYSTIC disease, or osteitis fibrosa cystica, has of recent years become more definitely known to the surgeon and radiologist, although, as far back as 1877, Virchow described a cyst in the upper end of the humerus, and because he found cartilage in the bone he ascribed the condition to the breaking down of an enchondroma.

It is well known that bone cysts may be single or multiple, and that they

more frequently occur in the long bones and more rarely in the small bones and in the skull. Silver, in 1912, collected together ninety-seven cysts of bone, and he found that the distribution was as follows:—

SITE.	NUMBER.	SITE.	NUMBER.
Femur	31	Calcaneum	2
Humerus	25	Radius	1
Tibia	15	Carpal Scaphoid	1
Phalanges	7	Metacarpal	1
Fibula	6	Astragalus	1
Clavicle	3	Metatarsal	1
Ulna	2	Pelvis	1

Elmslie, in 1912, described three cases of cysts of the upper end of the humerus; in each case a fracture had occurred at the site of the cyst; in two of the cases the fracture was produced by a fall, in the third it was produced by throwing an india-rubber ball.

The history of the case I am about to describe is as follows:—

G. R., a boy, aged 16 years, came up to King's College Hospital, in 1915, complaining of pain in the right shoulder joint, especially while drilling. There was no history of trauma. On examination, the movements of the shoulder joint were full but not quite free. The upper end of the humerus was distinctly enlarged but not tender on pressure. A diagnosis of myeloma or fibro-cystic disease of the upper end of the humerus was made. A skiagram was taken (Fig. 1.); it shows a definite cyst of the humerus close to the upper epiphyseal line. The epiphysis appeared normal, but there was a very thin layer of bone between the cyst and the epiphysis. The skiagram having confirmed the diagnosis of cyst, an operation was decided upon. The upper end of the humerus was exposed through a curved incision over the anterior surface of the bone. The humerus was exposed between the deltoid and pectoralis major muscles; the bone was very expanded and quite thin; an opening was made and a clear fluid containing cholesterolin was evacuated. This fluid was sterile on culture. The cyst wall, which appeared perfectly smooth, was carefully curetted with a sharp spoon. The pectoralis major and deltoid muscles were united over the hole in the bone and the wound closed. The arm was bandaged to a splint in the abducted position. The wound healed *per primam*, and skiagrams were taken at different intervals after the operation.

The cyst wall was examined microscopically and was found to consist of fibrous tissue. There was no sign of cartilage or giant cells. The small piece of bone that was removed showed absorption by osteoclasts and a thin layer of osteoid tissue. After six weeks the boy left London, and owing to active service I lost sight of him, but I heard in 1918 that he had joined the army. In 1921 I found that he was working in Ireland, and he came over to see me in June, 1922, just seven years after his operation. He had perfect use of his arm, and except for his scar there is no difference between the two arms (Fig. 5). The skiagram (Fig. 6) shows complete restoration of the upper end of the humerus, and it is difficult to believe that there ever had been a cyst present. He is working as an engineer, and uses a heavy hammer daily without any effort or distress.

Many theories have been put forward as to the causation of simple single cysts of bone, such as occur in the upper end of the humerus. For instance, they have been ascribed to hæmorrhage, or resulting from alteration in myelomata.

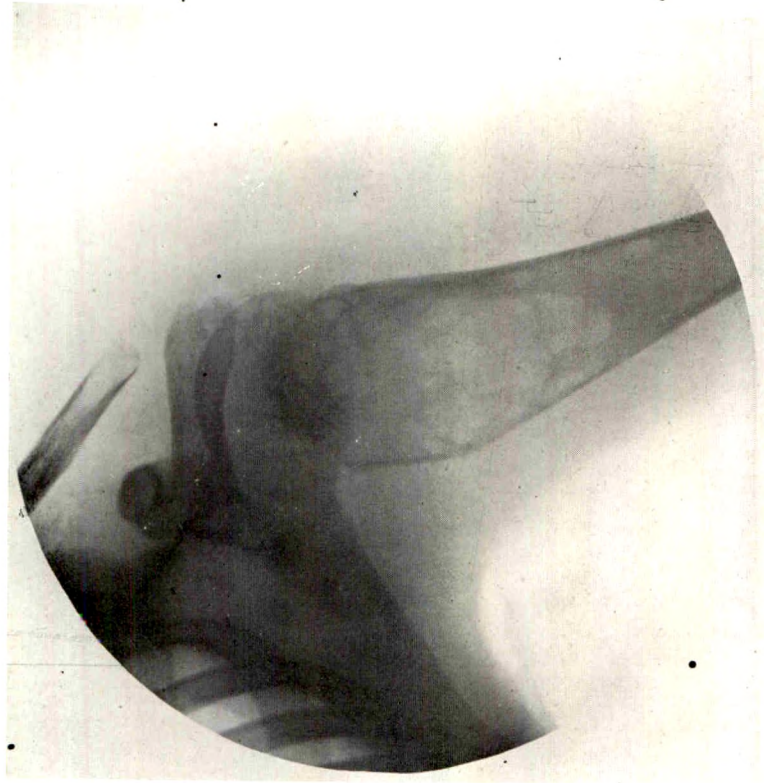


FIG. 2.—Skiagram taken in June, 1915, one month after operation.

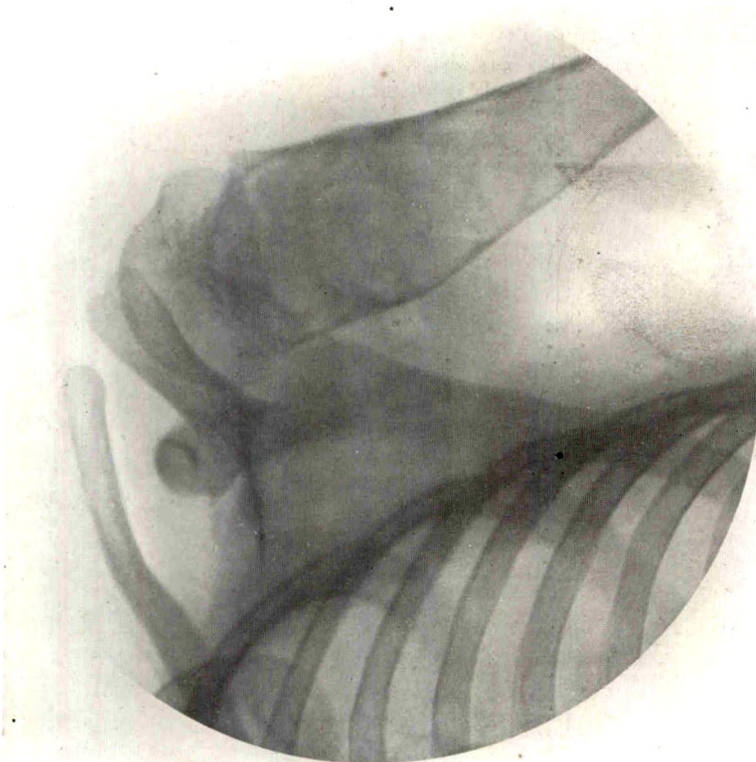


FIG. 1.—Showing definite cyst of the upper end of humerus, May, 1915, before operation.

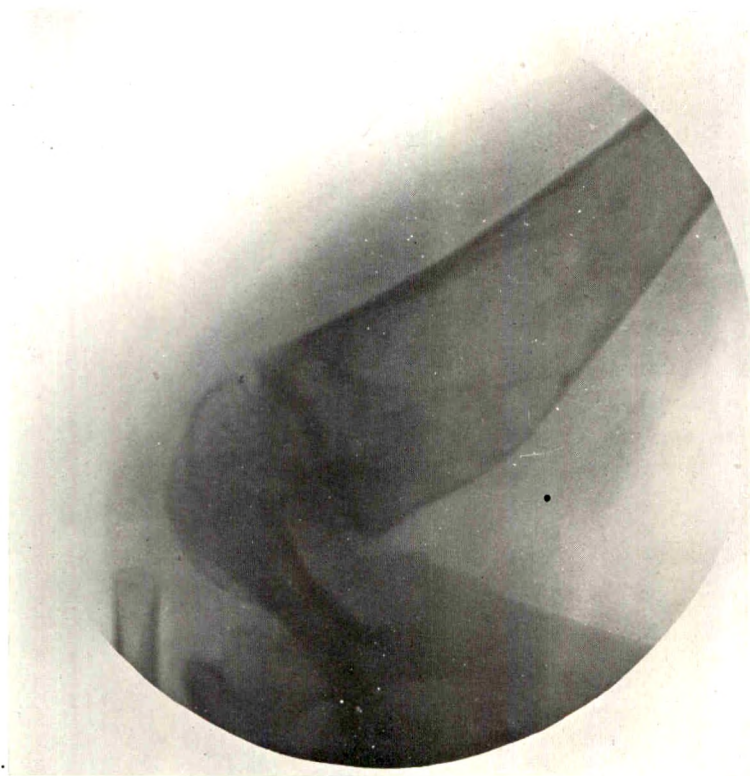


FIG. 3.—Skiagram taken in July, 1915, two months after operation. The compact bone on the outer side of the shaft is beginning to thicken.

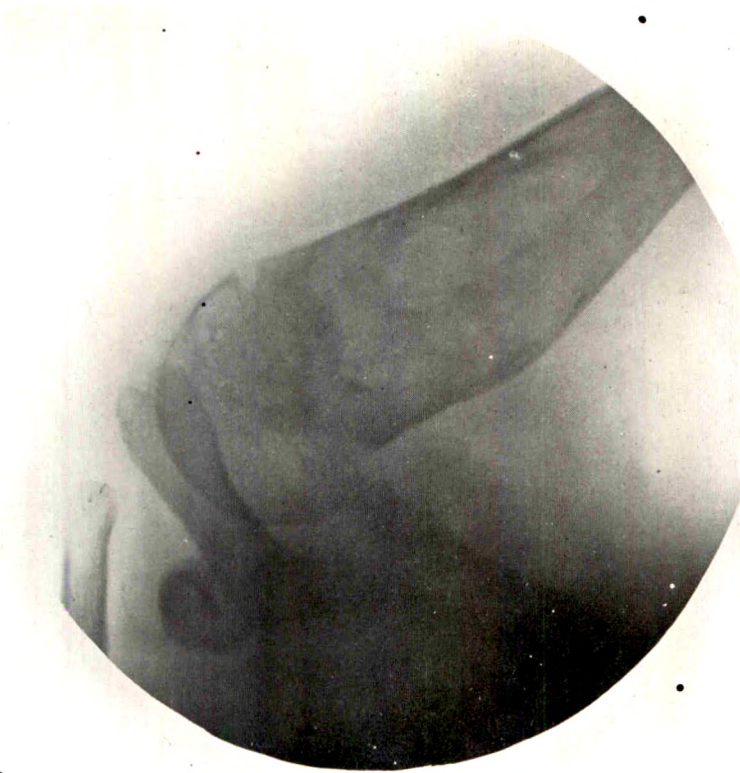


FIG. 4.—Skiagram taken two and a half months after operation.



FIG. 5.—Photograph of patient taken in June, 1922, just seven years from the date of the operation.

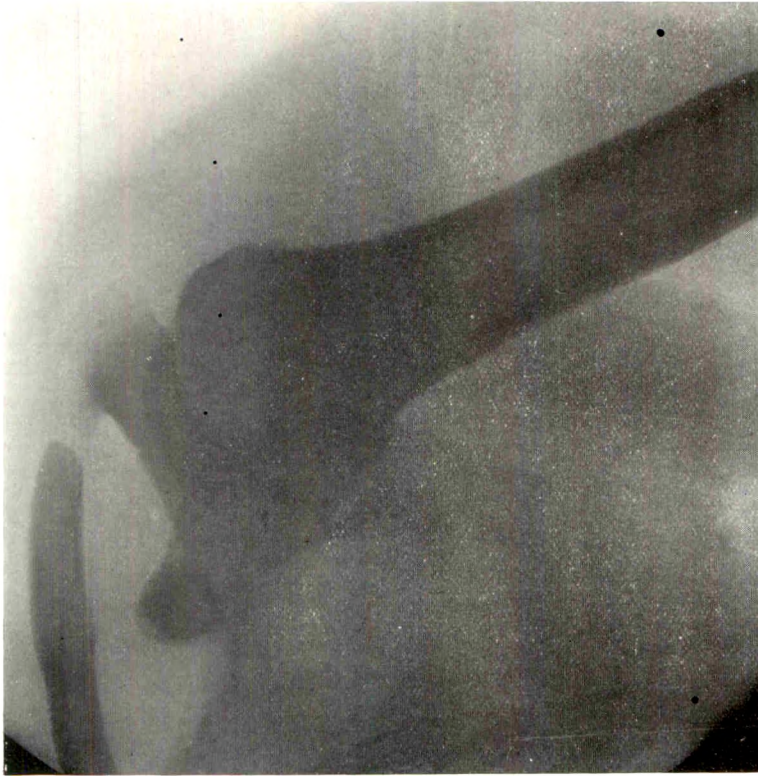


FIG. 6.—Skiagram of humerus taken seven years after operation. The bone appears normal in every respect.

Elmslie, in an up-to-date and classical article in 1914, to which we can add practically nothing from recent investigations, comes to the conclusion that, "It must be confessed that the present state of our knowledge of the pathology of bones is not such as to enable us to classify properly these fibro-cystic diseases. It would perhaps be better to state frankly that we cannot decide whether they are one disease or several; whether they are of the nature of inflammatory processes or new growths, or simple instances of disordered bone-growth; and be content with a statement of their clinical characteristics and their pathological characters, as far as these have been ascertained. For this reason the names, simple cyst, fibrous osteitis, fibro-cystic osteitis, myeloid cyst, etc., are all open to objection, inasmuch as they assume in some way or other that the nature of the process is understood. If we call the condition, or conditions, fibro-cystic disease of the bones, we make no such assumption; and we fall in with the system which has been adopted in other organs in which obscure cystic changes occur."

REFERENCES.

- Bloodgood, *Ann. of Surg.*, 1910, LII, 145.
 Elmslie, *Brit. Med. Jour.*, 1912, November 16th; *Brit. Jour. of Surg.*, Vol. II, No. 5th, 1914.
 Gask, *Brit. Jour. of Surg.*, Vol. I, No. 1, 1913.
 Jones and Morgan, *Archives of Röntgen Ray*, 1907, XI, 316 and 342.
 Silver, *Amer. Jour. of Orth. Surg.*, 1912, IX, 563.
 Virchow, *Monatsbericht, d. kgl. Akad. d. Wissenschaften*, 1876, 369.

A SIMPLE METHOD OF TREATING SUPERFICIAL LESIONS OF THE PERINÆUM AND INTRA-PELVIC CONDITIONS FROM BELOW.

By MAURICE R. J. HAYES, F.R.C.S.I.

Professor of Materia Medica and Therapeutics, University College, Dublin; Radiologist, Mater Misericordiae Hospital, Dublin.

It is not so simple as it would on first consideration appear to be to obtain ready access to the perinæum, and at the same time to place the patient in a position of comfort on the couch without risk of the high tension current sparking to the limbs.

When the patient lies on one or other side with the thighs flexed on the abdomen, the buttocks are not separated sufficiently to make access easy, and with all types of tube stands the tube terminals lie too close to the limbs, or to the top of the couch, to facilitate accurate focusing.

There is no danger of sparking to the body if the patient lies prone, but as in this position the limbs are fully extended, and the buttocks are in close contact, obvious difficulties are apparent, not the least of which is respiratory embarrassment, more especially with elderly patients. No doubt the perianal

region is accessible for the treatment of pruritis ani, but because the lower limbs lie so closely together it is impossible to irradiate the perinaeum satisfactorily if there be associated eczema of this part.

The recumbent position with the limbs apart is suitable for the treatment of pruritus vulvæ, etc., but here again the perinaeum, which may require treatment, can be reached only with difficulty, and the perianal region is inaccessible.

With most types of tube stands there is little danger of "shorting" to the patient's body if we employ the Trendelenburg position, but here also difficulties are confronted. This is a very uncomfortable position, more especially for those whose joints are stiff, as is frequently the case with elderly patients. In my experience males find the Trendelenburg position intolerable.

Doubtless other radiologists have experienced similar difficulties in treating this region, but I have found the following solution of it to be so simple and so satisfactory that it appears to me to be worthy of note. It consists of an ordinary board fashioned like a lavatory seat, but having a circular opening four inches in diameter, which I place across the end of the frame of my radiographic couch, the top of which latter can be easily lifted off. The couch I use is the War Office pattern universal X-ray couch, supplied by the Medical Supply Association. In this couch the tube box has longitudinal, transverse, vertical and rotatory movements, with simple devices for carrying filters, lead glass nozzles of various sizes, and a pastille holder, and it is capable of very easy adjustment in all directions.

When the patient is seated, the anal region, the perinaeum, or the vulva may be readily exposed. There is no risk of sparking to the patient's limbs, and there is no discomfort. A small opening in the seat is essential because it helps to keep the buttocks separated.

This position is so comfortable for the patient, and so simple and satisfactory in the treatment of superficial lesions of this region, and also of the deeper intra-pelvic conditions such as myomata, carcinoma, and enlarged prostate, that I am encouraged to describe it for the benefit of others who may possibly have had to encounter difficulties like mine.

I venture to suggest that manufacturers might with advantage consider the advisability of fitting a bevelled circular detachable piece into the tops of their couches at one end to serve the purpose which I have described. This would obviate the necessity of removing the top of the couch.

The accompanying photographs of my adaptation will illustrate the idea.

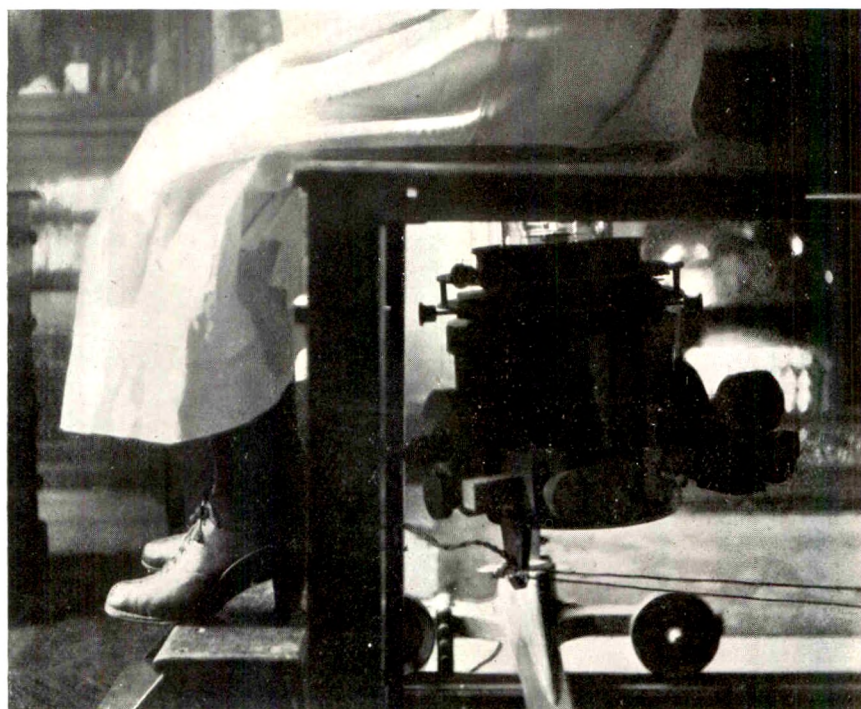
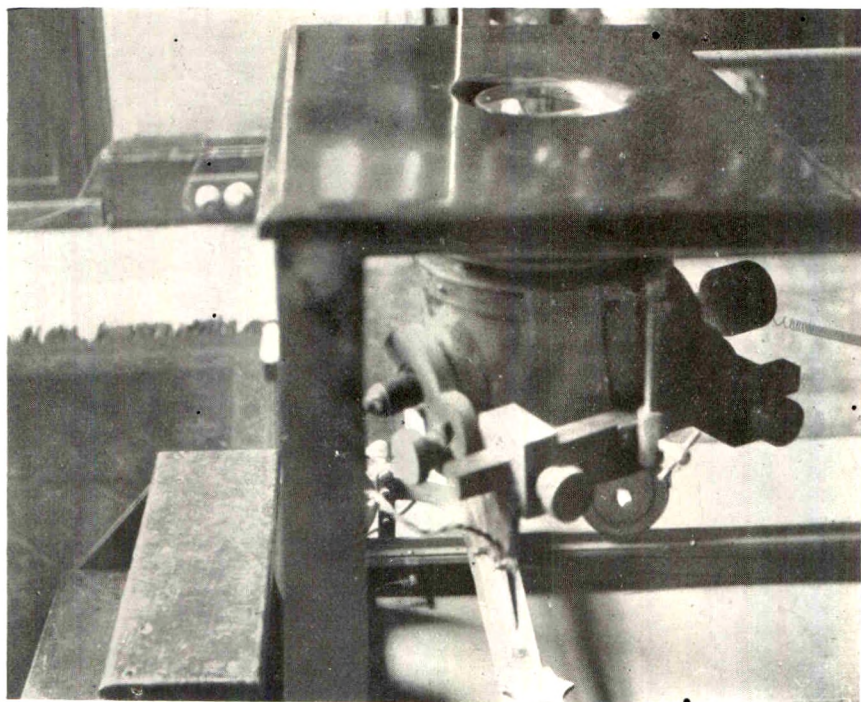


PLATE 6.

ACTA RADIOLOGICA.

Published by the Societies for Medical Radiology in Denmark, Finland, Norway and Sweden.

Editor: GÖSTA FORSSELL, M.D., Stockholm.

The following are the authors' abstracts of the articles of No. 3, Vol. I, 10th April, 1922:—

Comparative Researches upon the Motility of the Stomach.—OVE WISSING, Copenhagen (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 243-261).—The majority of normal stomachs empty within a lapse of time varying between two and three hours after the opaque meal, and in the majority of cases the barium gruel passes through the stomach somewhat more rapidly than the bismuth gruel.

The normal stomachs are far from always having a duration of evacuation approximately constant after the opaque meals, and the variations may allow of one or several hours.

There appear to be certain stomachs, normal in other respects, which possess an astonishingly irregular motility.

The conditions of the motility of the stomach have been, besides, examined in 217 patients suffering from various complaints of the digestive canal; the examinations were made either six hours after Kemp's test meal, or five hours after the ingestion of barium gruel (with 150 grammes of sulphate of barium). A retention of the barium after five hours ought probably to be considered as a manifestation of a motor incompetency, and for this reason the author recommends making the radiological examinations of the motility five hours (and not six) *post cœnam*.

It is shown from the above-mentioned investigations that the clinical method is that which gives the most exact information, for in almost all the pathological forms there was a much greater number of clinical retentions than with the barium gruel, whilst, to make amends, the radiological retention appears to be of considerably more importance when it does exist. The radiological test cannot, however, entirely substitute the clinical method, but the two tests can complete each other, for, by employing both, an increase in the duration of the evacuation is found more often than when only one of these methods is used.

The radiological tests have nothing "specific" in the sense of their furnishing particular

diagnostic information in certain gastric complaints, *e.g.*, the ulcer.

A retention of the barium for twenty-four hours (pseudo-retention) may exist without there being any ulcerous or cicatricial changes at the level of the pylorus; thus, for instance, in the atony and the ulcers of the body of the stomach.

In gastric ptosis, neither the low position of the stomach nor an atonic condition of the organ, nor both these factors combined, appear to have a cardinal influence on the duration of evacuation.

The "paradoxical" retention is of no essential importance for the diagnosis of the duodenal ulcer.

Clinical Examinations of a Four Hours Roentgen Retention.—TH. EIKEN, Copenhagen (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 262-265).—On comparing the different groups, it may be said, as a general rule, that the further away the disease is removed from the stomach the less is the influence on its emptying capacity, and we come nearer and nearer to the conditions which we find in the normal digestive canal.

As a result of the examinations the author ventures to say that, in a four hours' roentgen retention we have a delicate test of the emptying capacity of the stomach, a test which, however, must always be judged in association with the other clinical findings.

The examinations are steadily continuing, and will later be brought forward on a broader basis and in a much more fully worked-out form.

Roentgen Examination of Ileocaecal Tuberculosis with Special Reference to the so-called Stierlin Sign.—P. FLEMING MÖLLER, Copenhagen (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 266-273).—The so-called "Stierlin Sign" in ileocaecal tuberculosis has not the great diagnostic value which Stierlin has ascribed to it. It is certainly a relative rarity.

The roentgen picture of ileocaecal tuber-

culosis, and the other tumour producing complaints in the ileocaecal region, commonly corresponds to the well known picture of other tumour formations in the digestive tract, and has as diagnostical sign-marks:—

(1) A pathological diminution of the shadow of the caecum-ascendens.

(2) An abnormal shape and contour of it, in analogy with the shadow defects in cancer ventriculi.

(3) An inexpandibility and stiffness of the intestine wall.

The Niche Symptom in Carcinoma Ventriculi.—AKE AKERLUND, Stockholm (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 274-283).—The internal treatment of niche-formed gastric ulcers, which is being ever more and more employed, brings increased responsibility (in its train) for the roentgenologist in the interpretation of verified gastric niches.

According to a report on the rather sparse X-ray literature appertaining hereto, over seven cases of niche-formed carcinomatous gastric ulcers are recorded, which during the period of a few years have come under observation. In three of these cases the correct diagnosis was made at the first roentgenological examination; in a further two it was expressly stated that carcinoma could not be precluded.

It can happen that the determination of acidity in niche-formed cancerous ulcers gives normal values. The presence of niches in older, hitherto healthy-stomached persons is to be interpreted as a serious warning; a typical niche localisation is also suspicious of carcinoma.

The tracing of a hard, stiff, wall- or plateau-like infiltration in the neighbourhood of the niche—which infiltration can now and again appear more distinctly on the plates that have been taken from direct compression—strengthens one in this suspicion. In uncertain cases a speedy control examination should not be neglected.

The Topographical Conditions of the Interlobular Fissures of the Lungs.—S. KREUZFUCHS and O. SCHUMACHER, Wien (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 284-307).—If we summarise the most important experiences from our investigation, we arrive at the following:—

The median interlobar fissure is triangular

in shape, with dorsal, short base and ventral apex. The surface is anteriorly and laterally steep and convexly curved in the same direction cranialwards.

The lateral border or the median interlobar incisure (fissure-inlet) is forwards descending, frequently adherent medially. It presents the form of a recumbent S, but is also curved in conformity with the thoracic curve.

The posterior border or section-line with the principal fissure represents the cut of the middle lobe wedge, and lies transversely in the transverse section of the body. But this line is often not to be seen on the floor of the fissure, as parenchymatic or pleural bridges extend from the posterior lobe to the middle lobe.

The medial border forms the pleural sac from the superior lobe to the middle lobe. It is very variable, and thereby also the so-called depth of the fissure. It always lies in sagittal direction, and can reach to the medial anterior border of the lung.

The fissure is so located in respect to the hilus that its most posterior and medial point lies exactly opposite to the so-called depth of the fissure, hence the "hilus near point." The level of the fissure is between the hilus centre and the lower margin of the hilus.

The principal fissures show right and left differences, both in regard to the direction of their course, the curve of their surfaces, the height of their dorsal portions, and the section line of the base of the lung; both are approximately oblong and surround the hilus at the medially located pleural sac; their surfaces are, therefore, approximately kidney-shaped. The left one extends higher up, the highest dorsal point lies in a third of the apex distance of the diaphragmatic dome, the medial anterior border line lies farther medially than to the right, the base of the lung is cut farther forwards than to the right.* Both are propeller-shaped; the right one more pronouncedly so than the left.

Radiological Methods for the Determination of the Conjugata Vera.—T. KLASON, Stockholm (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 308-318).—The procedure for the radiological measurement of the pelvis is given in

* The curving is to the left more steep than to the right.

the employment of the localisation method of Mackenzie-Davidson. The method is based on the works of Manges, Runge and Gruenhagen; Guilbert, Lévy-Solal, and so on.

Two exposures are necessary. For the execution of the measurement, the focus-plate distance, the displacement and the ortho-projection of the focus on the plate must be known. These points are marked on the cassette holder by the help of a mirror arrangement with lead marks. For measurement, the plates are placed on each other in the same position as for their exposure, after which the images of the lead marks and the images of the end-point of the required diameter are drawn on tracing-paper. A stereoscope is then often necessary. These latter are to be connected with the focus-point appertaining hereto, and the distance of the point of intersection thus obtained gives the ortho-projection of the required diameter. The height of both end-points above the plate level must also be determined. By the base of the rectangular triangle that is formed from the focus, its ortho-projection and the image of the end-point, one knows the orthodiagraphic projection of the required point, and has thereby all values that are necessary for the calculation of its height above the plate level. The lesser height is now deducted from the greater, and from the one end-point of the ortho-projection of the required diameter the figure obtained is recorded in cm. The distance between the point so obtained and the other end-point of the ortho-projection of the diameter gives the required diameter.

The conjugata vera of a symmetric pelvis can also be determined by a single exposure, if the ortho-projection of the middle line and the focus are noted on the plate. (The focus laterally from the middle line.) The determination takes place in a manner analogous to the previous one.

If during the exposure two metal rods are placed vertically on the plate level—the one of them provided with a centimetre scale—the determination can be effected also through a construction, without knowing the focus plate distance and 0-point (see further in the article).

By taking lateral pictures of the pelvis, the author has, with the employment of sufficiently

hard light and careful development, obtained pictures on which the symphysis as well as the promontory appear with satisfactory distinctness. It was thus possible to determine the true conjugate of a symmetric pelvis, if the plate had been placed parallel with the sagittal level of the body, and the focus plate distance as well as the distance of the focus middle line were known.

Os Vesalianum Tarsi and Fracture of Tuberositas Ossis Metatarsi V.—CHR. I. BAASTRUP, Copenhagen (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 334-348).—At the proximal extremity of the os metat. V appear two forms with the likeness of epiphysis:—

1. The "apophysis," a frequent, perhaps constant, shell-formed epiphysis on the latero-plantar part of tuber. V. The ossification of it commences in the tendon of muse. peron. brevis.

2. The proximal part of tuber. V has now and then a certain independence, showing a special centre for ossification. Occasionally a terminal form like an epiphysis may be seen, which at autopsy in the three cases hitherto examined has proved to be not an epiphysis but an independent bone: os vesalianum tarsi.

Tuberositas ossis metat. V corresponds morphologically, phylogenetically and ontologically to the vanished os tarsale V in the distal row, and os vesal. must be understood as an atavically appearing os tarsale V.

The fact that os vesal. is so seldom found, though more frequently than was formerly supposed, supports the supposition that os tarsale V disappears at an early stage in the development.

In further agreement with this theory is the fact that an os tarsale V is only found in toads, reptiles, and in the embryonic life of the lowest class of mammals.

The theory is sustained by the mutual position of the bones in the early stages of the human embryonal life.

Now and then os vesal. and the above-mentioned apophysis are mistaken for fracture of tuber. V. Several different circumstances in the anamnesis and in the roentgen photos help to make the differential diagnosis.

The usually stated criterion for recognition of the genuine bones—that they are bilateral—cannot be maintained as a necessary claim.

PUBLICATIONS RECEIVED.

Books.

X-ray Dosage in Treatment and Radiography. By W. D. WITHERBEE, M.D., and J. REMER, M.D. (The Macmillan Company, New York.)

La Radiothérapie Profonde. By ISEK SOLOMON. (Masson et Cie, Paris.)

Bulletin S. 51. (Watson and Son (Electro-Medical) Ltd.)

Journals.

L'Actinoterapia, January, 1923.

American Journal of Surgery, December, 1922.

Archives de Médecine et de Pharmacie Militaires, August, 1922.

British Journal of Dermatology and Syphilis, January, 1923.

British Journal of Surgery, January, 1923.

Bulletin of the Johns Hopkins Hospital, December, 1922.

Bulletins et Mémoires de la Société de Radiologie Médicale de France, December, 1922.

Bulletin Officiel de la Société Française d'Electrothérapie et de Radiologie, November, December, 1922.

La Chirurgia degli Organi di Movimento, November, 1922.

Electricidad Médica, November, 1922.

Journals—continued.

Health, January, 1923.

Hospitalstidende, November 29th; December 6th, 13th, 20th, 27th, 1922.

International Journal of Orthodontia, Oral Surgery and Radiography, December, 1922.

Journal of Laryngology and Otology, January, 1923.

Journal de Médecine de Bordeaux, December 25th, 1922; January 10th, 1923.

Journal de Médecine de Lyon, December 20th, 1922.

Journal of the Röntgen Society, January, 1923.

Medical Journal of Australia, November 11th, 18th, 25th; December 2nd, 1922.

Medical Science, January, 1923.

New York Medical Journal and Medical Record, December 20th, 1922; January 3rd, 1923.

Il Policlinico, December 1st, 15th, 1922.

La Radiologia Medica, December, 1922.

Strahlentherapie, Band. 14, Heft. 3, 1922.

Surgery, Gynecology, and Obstetrics, January, 1923.

Ugeskrift for Læger, December 21st, 28th, 1922.

Urologic and Cutaneous Review, December, 1922.

NOTICES.

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A list of collaborators at home and abroad is being prepared and will be published at an early date. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

THE RADIATION OF THE TRUE PELVIS WITH THE HELP OF DRAINAGE TUBES.

By Dr. FRANS DAELS (Ghent).

In a lecture delivered at the Flemish Congress of Medicine at Antwerp in 1919, I discussed one of our fundamental principles of radiumtherapeutics, namely, the backward irradiation of tumours, that is to say by way of their basis of insertion and of propagation through the lymphatic system. I demonstrated the application of this principle in the treatment of inoperable cancer of the breast by placing radium tubes behind the tumours.

In a communication made to the "Académie de Médecine de Belgique" in June (1921) I described in detail our first attempts at radiation of the true pelvis upon such principles. At the "Congress of Obstetrics" of Paris in September, 1921, I was able to describe an advance in technique, and reported a first series. A wider experience since then has enabled me to simplify the method of treatment, details of which will now be given.

The true pelvis is the seat of numerous kinds of malignant tumour, glandular metastasis of which rarely takes place. Extensive removal by operation of these tumours is sometimes dangerous, and when successful is no guarantee of a radical cure. This is equally the case with cancer of the cervix uteri, cancer of the vagina, highly situated cancers of the rectum, cancer of the prostate, cancer of the vesical floor, all the glandular metastases and all the inoperable tumours.

Surgical extirpation of cancer, more and more extensive, does not solve the problem. The public is not very much impressed by a slight increase in the percentage of radical cures, and is much more struck by a corresponding increase in the mortality after operation. The final result is, broadly speaking, a breakdown in the struggle against cancer, as patients still try to avoid all surgical treatment.

Anti-neoplastic vaccination is still in the stage of experiment. On the other hand, "Curie" therapy and X-ray therapy may lead to complete cure. Not only do these methods set up massive tissue-necrosis, but they also lead to selective regression of neoplastic tissues.

The X-ray can hardly reach the deep metastases; the decrease of the irradiation with the square of the distance and the necessity of reaching the deeply situated elements of new growth in a cross-fire of a series of X-ray bombardments render the techniques difficult.

The extent of tissue through which the X rays must pass to reach the deep parts is of great thickness, and only a very small fraction of the absorbed irradiation is available for use. The action upon the blood is intense, and so is the alteration of the general condition.

In the irradiation techniques of cervical cancer by Winz's method—which up to recently yielded the best results—the irradiation of the cervix can only be followed by that of one parametrium after an interval of six weeks, and the irradiation of the other parametrium can only be undertaken fourteen weeks after the beginning of the treatment. The fact that other German clinics have obtained only 28 per cent. of cures instead of the 90 per cent. obtained after three years by Winz emphasises the difficulty of the technique.

"Curie" therapy by means of plates or radio-active tubes appears to develop a more selective action upon the neoplastic tissues, but this action is more localised as the intensity of the irradiation has become reduced, and its therapeutic action does not extend deeper than 3 cm. The application of radio-active needles or the insertion of emanation-tubes into the interior of the tumours ought to exercise a more extensive action, but no marked improvement appears to follow the application of this technique to the deeply-seated paths of extension by way of the lymphatic system.

In collaboration with Dr. De Backer, I have studied the effects of mixed irradiation of the true pelvis by means of X rays applied by way of the abdominal, sacro-sciatic and ovarian routes, and by means of inserting radium tubes into the vagina, the uterus, the rectum and the bladder.

In the search for a more systematic guarantee of cure we applied to the true pelvis our principle of treatment, which consists in irradiating the malignant tumours backwards in the zone of their propagation and most dangerous proliferation, and also in bombarding the whole of the cancer tissue together with the glands in a cross-fire of rays. In the case of cancer of the cervix uteri the practical realisation of this principle consisted in the insertion of radium tubes into the centre of the tumour, and into the connective tissues of the true pelvis, in the neighbourhood of the glands, and on both sides of the tumour.

A radium tube exercised a beneficial action in an area of 2 to 3 cm. With three different ways of irradiation in the true pelvis, the greatest diameters of which are 13 to $13\frac{1}{2}$ cm., we may hope to reach our aim and to be able to free the true pelvis of all cancer cells.

In order to ensure methodical radium irradiation deep within the connective tissue of the true pelvis, it is necessary to place and keep the radium tube within well-defined regions. For this purpose we have conceived the idea of conducting indiarubber drains, containing radium tubes, through the pelvis, so as to establish what may be called radiumtherapeutic drainage of the true pelvis.

The combination of this irradiation with irradiation through the surface of



FIG. 1.

the body and through the natural cavities, must result in enabling us to develop a most useful method of "cross-fire" in the interior of the true pelvis.

We planned the method of radiumtherapeutic drainage, following various courses, according to the lymphatic currents and the situation of the tumours that were to be irradiated; drainage from the iliac crest towards the sacro-iliac articulation, and outlet through the great sacro-sciatic foramen ligament and alongside the coccyx, or more forward just beneath the ischium, or higher up along the ischio-pubic branch, passing for the greater part above the levator ani; that is, a drainage from the great sacro-sciatic foramen to the ischio-pubic branch.

The researches carried out by my assistant, Dr. De Bruyne, upon the cadaver, prove that these various routes are practicable in the treatment of rectal, vesical, and prostatic tumours. In some of his tracings now shown

you can recognise the various courses taken by the drainage in the true pelvis.

Other researches made upon the cadaver by a second assistant, Dr. De Rom, prove that a gynaecological radiumtherapeutic drainage is practicable when carried out correctly. Some of Dr. De Rom's tracings now shown demonstrate this. We have only recently begun to put this gynaecological radiumtherapeutic drainage into practice, under very varied conditions.

What structures shall we irradiate in the depth of the true pelvis? More especially the external and internal iliac glands and the lymphatic channels along the uterine arteries. Their size is shown on the tracing. They can only be reached imperfectly by X rays or radium rays from the surface of the body or from the natural cavities of the true pelvis.

What are our operative landmarks? The iliac crest, the psoas muscle, the iliac vessels, the sacro-iliac articulation, the sciatic spine and the ischium.

TECHNIQUE OF THE IRRADIATION.

To carry out the method the following are needed: (a) Rubber gloves; (b) a bistoury to incise the skin and the aponeurosis; (c) an indiarubber drainage tube 10 to 12 cm. long, containing one, two or three radium tubes; and (d) a chain, the size of the links being 1 cm., and each link divided into two halves. The drainage tube is firmly attached to the chain by means of some stitches, and is sterilised at the same time with the instruments before introducing the radium tubes.

The chain which passes through the drainage tube is 80 cm. long; 25 to 30 cm. remain at one extremity of the drain and 30 to 40 cm. hang out at the other extremity. The longest end of the chain finishes in an eyelet. At the other end we fasten at the twentieth link a piece of thread in order that at any moment the distance of 10 cm. from the first radium tube may be recognised.

Further we need: a half-circle, round in its section and hollow, 1 cm. in diameter, graduated on two sides in centimetres and half centimetres, and 40 cm. long. Its radius is 17 cm. long. The end of this half-circle is broader and stronger in order to give a better grip to the hand of the operator. Through this hollow half-circle we can slip a metal thread, which ends in a hook.

The insertion of the radium drains is carried out in the following manner: Incision of the skin over a length of $1\frac{1}{2}$ to 2 cm., on the left and right side of the anus between the anus and the hindermost part of the ischium. The forefinger is brought through the opening into the fossa ischio-rectalis; the perirectal floor and the sciatic spine are felt by it; it penetrates between the iliac and coccygeal parts of the levator ani into the connective tissue of the parametrium. The finger can penetrate deeply into these tissues, but it can seldom reach as far as the sacro-iliac articulation.

We now slip the end of the half-circle along the inserted finger and so we measure the distance between the spine and the skin; 7—8—9—seldom

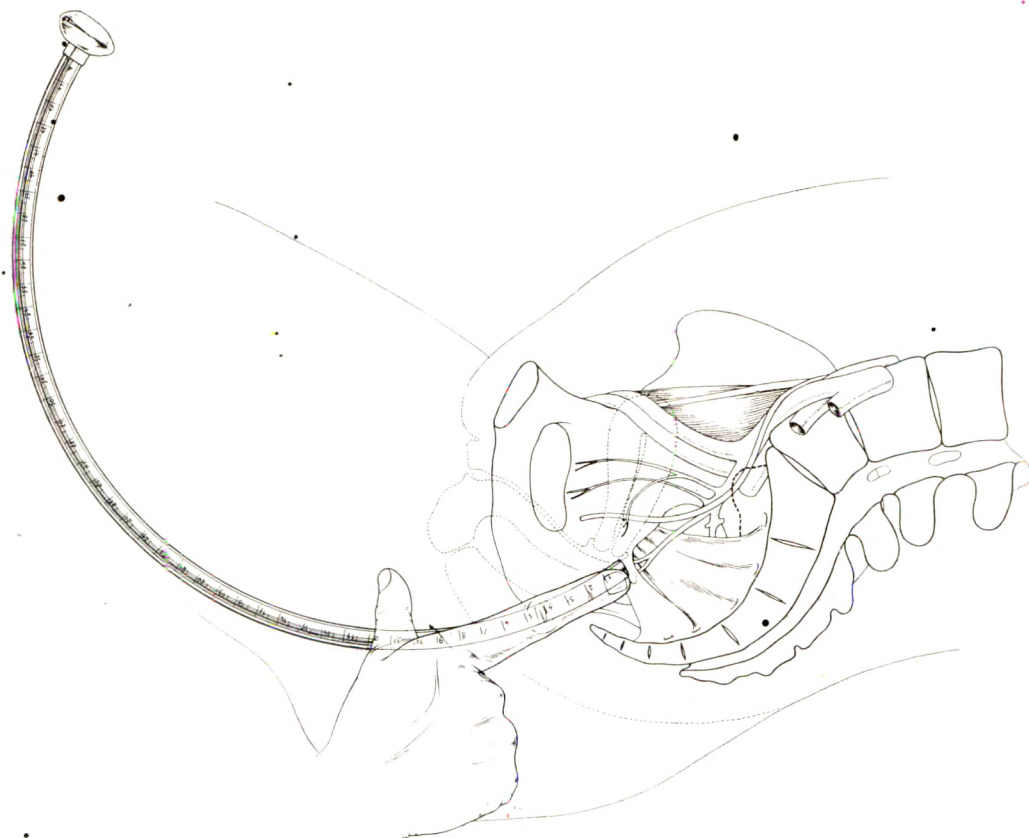


FIG. 2.

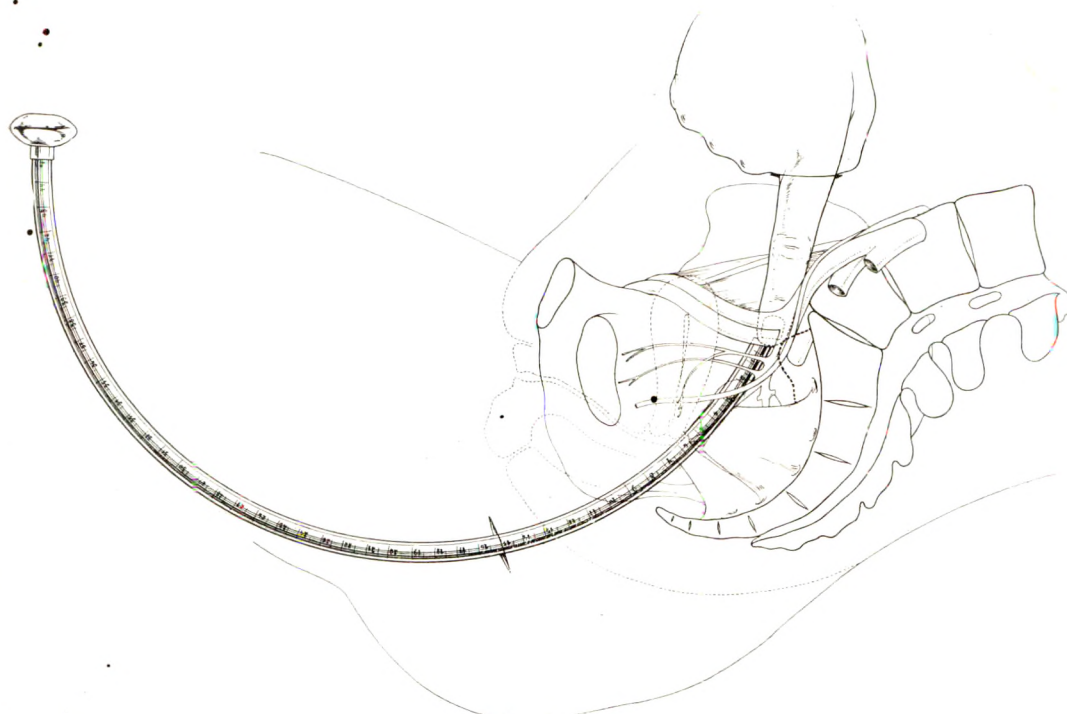


FIG. 3

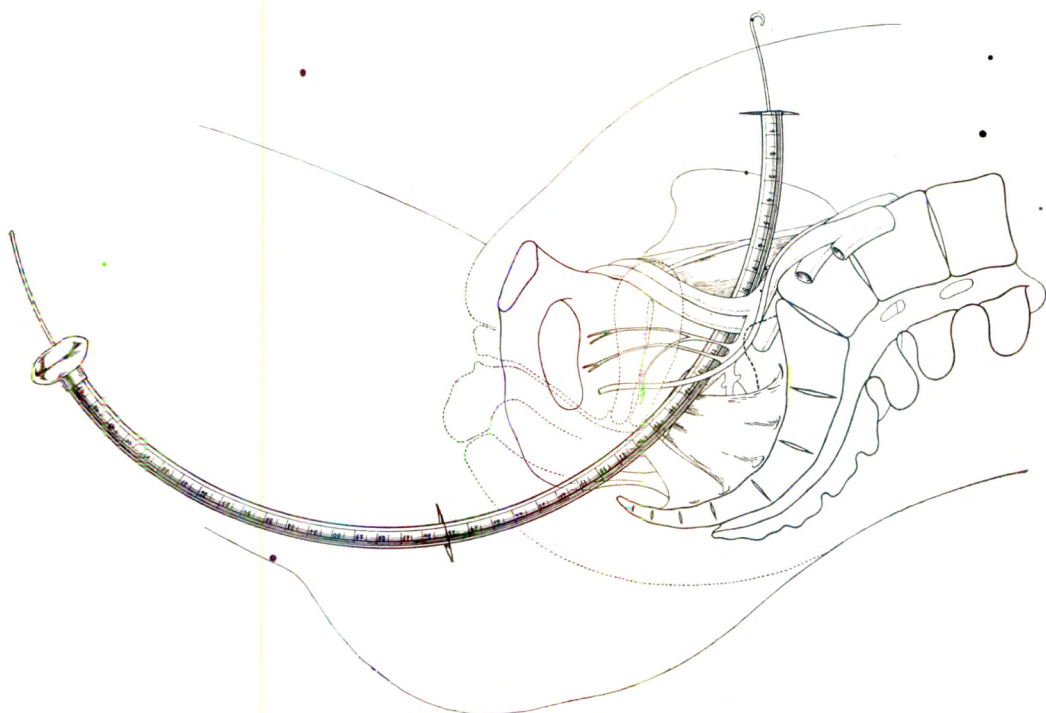


FIG. 4.



FIG. 5

10 cm. We conduct the point of the half-circle through the two parts of the levator ani and push it further into the connective parametric tissue.

An assistant holds the instrument in position. Superior incision of the skin 2 cm. inwards to the anterior part of the iliac crest. With the bistoury or the curved scissors we penetrate the aponeurosis and the forefinger introduced passes over the iliac and psoas muscle until it reaches the great vessels, which are recognised by the arterial throb. The finger passes beneath the vessels until the sacro-iliac articulation is reached. With the free hand we conduct the half-circle already introduced into the parametrium till it reaches the sacro-iliac articulation. We read the figures from the half-circle in the place of the inferior incision, and so we know the length of its course into the true pelvis—9 to 10 cm., seldom more.

If we now push the half-circle behind the retiring finger as far as the superior incision and again read the figures at the level of the inferior incision, we know the distance from the sacro-iliac articulation to the skin: 8—9—10 cm.

We slip upwards through the circle the silver thread ending in a hook. On this hook we fix the eyelet of the chain, and so we conduct this chain through the circle. By pulling upon the silver thread or upon the chain itself we keep the drain steadily in position on the tube or in the opening of it. By a backward movement of the circle this is taken out of the body and the drain is left in the pelvis.

The rubber tube with the radium must be placed in such a manner that its superior extremity reaches over the linea innominata and its inferior extremity under the sciatic spine, in order not to give it the opportunity of remaining hooked at the moment it is moved further at a later date.

The eyelet of the chain that hangs out of the inferior incision is fastened to the upper end of the chain over the abdominal wall. Safety-pins are passed through the first free link at the upper and lower incision and so the chain with the drain is steadily maintained in its place. Safety-pins may be inserted at the point of distance to which the chain will have to be moved.

If this drain contains radium in its full length, it is then left in the same place for some hours and after that is at once removed through the inferior incision by pulling on the chain. If only a part of the rubber drain contains radium, it should be moved several times in order to irradiate the same level of the true pelvis. The required amount of displacement is easily ascertained by pulling on the chain, and accurately graduated by means of the links measuring 1 cm. and $\frac{1}{2}$ cm. The radium tube remains in the area under irradiation for ten, fifteen or twenty-four hours, according to the amount of filtration employed. The most suitable doses for irradiation should be determined by clinical experience.

After the removal of the drain the chains are left in place for from five to ten days. I here show a radiograph of large rubber drains inserted through the pelvis and a radiograph of chains lying in the pelvis.

As I already stated, our first series of cases were treated in rather different ways.

I shall not explain why careful experiments were made in various directions. It will be sufficient to explain why different methods of technique were abandoned. I am demonstrating the steps of the operation in the clinical picture. Only the insertion of the circle and the introduction of the thread on the left side, and the introduction of the thread in the circle and the removal of the circle on the right are in evidence. The remainder of the operation is out of sight owing to the fact that only the back of the surgeon is visible.

(My other film I regret has been held up by the customs.)

The introduction and insertion of a great rubber drain through the whole pelvis, from the superior to the inferior incision, has been abandoned on account of its occasioning excessive tissue-distension and necrosis.

If the drain be dipped in oil of camphor the indiarubber becomes lax and loses its power of resistance.

If we left the drain in the pelvis for two to three weeks for the purpose of twice irradiating the lymphatics, too abundant a suppuration was set up. Therefore in order to lessen the amount of this suppuration we now always insert the radium tubes at once in the drain so that the irradiation is begun as soon as the drain is placed in position.

At first we heavily irradiated the cervix cancer, and after three to four weeks we took in hand the radiumtherapeutic drainage of the pelvis as soon as the cancer wound was cleansed. I think that the passage of our graduated circle through the pelvic tissues may encounter difficulties due to tissue-change consequent on the first irradiation. On the other hand, irradiation of the cervix cancer, after the insertion of the radium tubes deep within the pelvis, accentuates the suppuration of the operative wounds.

The best course in my opinion is to carry out erosion of the cervix, irradiation of the cervix and radiation of the deeply situated lymphatics on both sides at the same time. If that cannot be done, it is preferable first to irradiate the cervix crater and immediately afterwards to undertake radiumtherapeutic pelvic drainage.

A rise of temperature or a bad general state, even amounting to cachexia, are no contra-indications to the treatment.

We leave the chains in position for from five to eight days and allow the incisions to gape widely.

RESULTS.

I will now explain a new method of treatment. Properly I ought to give an account of all that has been attempted by this method, even of the very first and incomplete attempts. After these first attempts the method entered a state of systematic development and improvement. The results to be reported refer especially to that period. We are entering upon a third stage, that of an established technique and of a more accurate study of dosage.

Our very first attempts at inserting drains through the true pelvis and of careful but too weak irradiation of its deeply-situated tissues, were made in the following cases: (1) A case of widely extending and deeply infiltrating

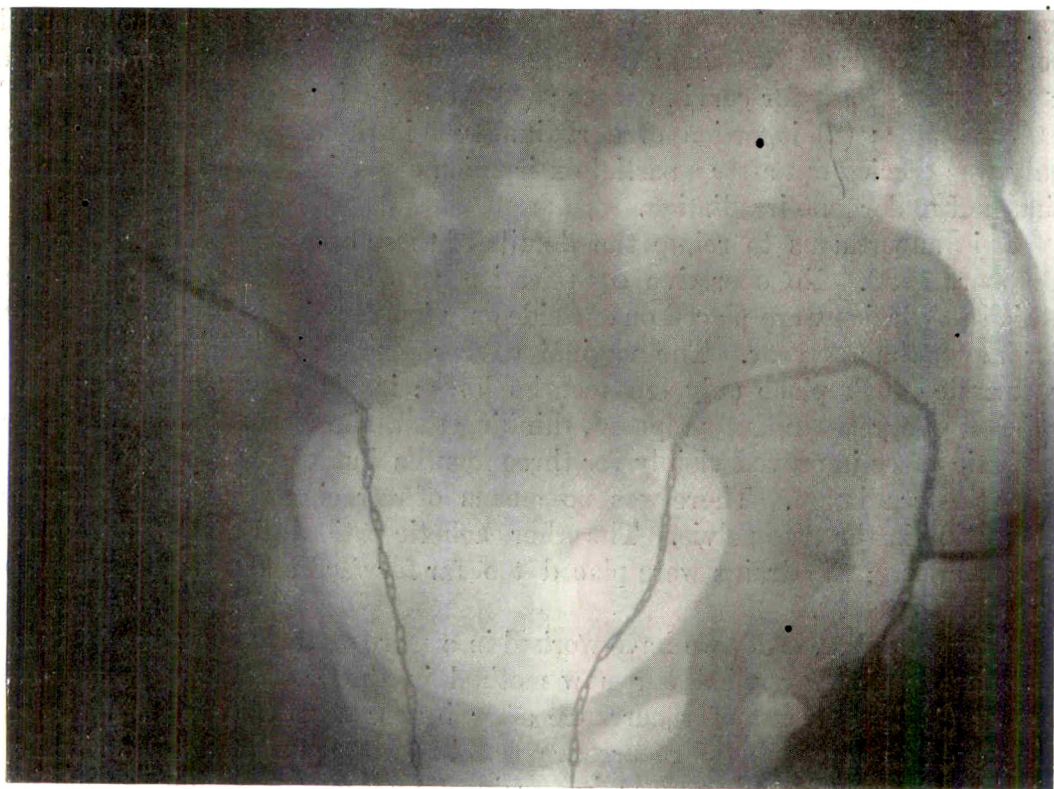


FIG. 6.

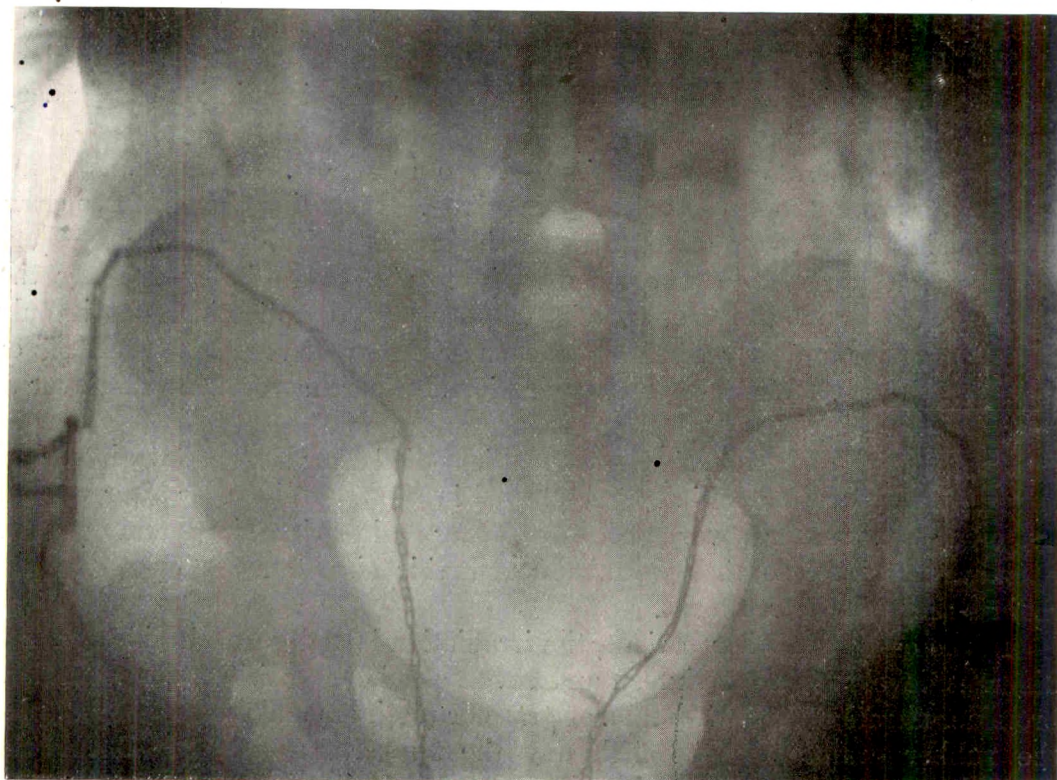


FIG. 7.

vaginal cancer (insertion of the radium tubes in the direction of the internal aspects of the crural vessels); (2) a case of widely extending pelvic recurrence after hysterectomy for cervix cancer; (3) two cachetic cases with wide cervical cancer crater; (4) insertion of a radium tube in the deep tissues on one side only was carried out after a partial extirpation of an inoperable cervix cancer that had undergone irradiation.

It is superfluous to relate the details of these cases treated from May to October, 1920. No operative complication was encountered. The case in which the drains were placed on one side only has remained without recurrence for more than a year. The vaginal cancer was partially extirpated. A recurrence took place only ten months later: in the meantime the patient refused every treatment proposed, thinking that she was cured. One of the cachetic cases improved visibly for three months but died in the sixth month after the irradiation. There was no means of retracing the former course of the drains in the true pelvis. The other cachetic patient died a fortnight after the operation: the drains were placed too far forward and passed in front of the uterine artery.

From October, 1920, we have worked in a more systematic manner. Since that date we have applied our new method in the treatment of twenty-two cases: (1) Three cases of recurrence after hysterectomy. One of the cases diagnosed as a lymphatic recurrence could not be examined histologically; (2) fifteen cases of cervix cancer, inoperable on account of wide extension into the parametria, into the vagina or into the bladder wall; (3) four operable cases of cervix cancer. In three of these cases we have carried out vaginal hysterectomy, twice at the time of insertion of the radium tubes, and in the remaining case several days before the irradiation of the deep tissues.

Immediate Operative Complications.—None up to now.

For the present, only a summary is given. Including the first five cases mentioned and the twenty-two cases of the second series, we have at present twenty-seven patients in whom the radium tubes were inserted along the lymphatic paths of the true pelvis without any complication. It is only necessary to work slowly when we encounter the great vessels, the glands or sclerosed tissues. We never had any serious hæmorrhage, nor had we ever to ligature a vessel.

Post-operative Complications.—One patient died after a week from intestinal obstruction caused by a kink of the bowel in the operation scar after vaginal hysterectomy. The recovery of the two other patients irradiated and operated upon was tedious, so that we abandoned this simultaneous operative and radium therapeutic treatment.

In the case of another patient, the irradiation lasted on each side at three different levels, twelve, sixteen and seventeen hours, with 50 mgr. radium bromide, filtration through $\frac{1}{2}$ mm. of brass or platinum and 1 mm. of lead, plus the rubber drain. On the fifth day the temperature was 37° C. and the general state excellent; we thought we were justified in suturing the two

incisions. This was the only case in which we attempted it. Two days later the patient had violent rigors and a temperature of 40° C. We opened the wound immediately, some purulent matter escaped and the temperature fell to 37° C. The following day, at the moment of straining at stool, violent hæmorrhage set in, and this caused the death of the patient, notwithstanding the fact that we tamponed the passage of drainage. At the autopsy we did not trace the vessel from which the hæmorrhage had proceeded.

In the case of a third patient, aged 55, excessively weak but without any pathological changes in her urine, there was complete atony in the course of the drainage and of the incisions, which were situated several centimetres from the radium tubes. She had a slight rise of temperature before the insertion of the radium tubes, and this rise continued after the irradiation until the death of the patient six weeks later.

The operative mortality occasioned by the insertion of radium tubes into the deep pelvic tissues was thus three out of twenty-two cases, *i.e.*, about 13 per cent.; but every scientific critic will admit that the first patient died from a complication of the vaginal hysterectomy and not of the radiumtherapeutic drainage, and that the second patient died from a complication resulting from a too hasty suture of the incisions which never occurred after this. The post-operative mortality really to be ascribed to the insertion of the radium tubes into the deeply situated area of the pelvis, according to our present technique, would be one in nineteen, *i.e.*, 5 per cent.

In one patient, in whom a great parametric cancer tumour arose from the right vaginal wall, the tumour disappeared completely; three months later, however, a wide fistula appeared between rectum and vagina. Whether in this case the fistula was caused by the necrosis and absorption of the tumour or by a radium ulcer we cannot tell at present. A second patient, in whom the tumour was distinctly bulging out into the rectum, now complains of a great pain in the rectum. A small temporary fistula between the bladder and vagina appeared in a patient after vaginal hysterectomy following irradiation, but it healed spontaneously.

The other post-operative complications were of no importance. In the case of three patients suffering from a wide cancer crater, who had fever at the time of the radium drainage, abscesses arose in the course of convalescence; they burst open through the upper and lower wounds; they were cured without any complication.

Small rises of the temperature usually take place during the irradiation of the lymphatics and some days later; they, however, disappear in the course of the second week without any complications. Generally the upper wounds cicatrise in the course of the second week, the lower in the course of the third or fourth week.

In the case of a patient with extensive vaginal cervix cancer the lower wound remained moist for two months and at that place a stubborn eczema broke out. Three patients had slight transitory neuritic pains in the lower limbs; a patient who was brought to us in a cachectic state and with a fever

of 40° C. (wide cancer crater) was so weak in the legs for a fortnight that she could hardly walk: afterwards she recovered completely.

Clinical Cancer Cures.—After eight to twelve weeks our patients are in a state of clinical recovery from cancer, even the widest cancer craters closed and transformed into cicatrices. Up to now we can only enumerate three exceptions in which a greenish wound has persisted for four and six months; and now arises the question whether we are not confronted with cases of ulceration caused by radium. We do not venture to remove small pieces to diagnose them microscopically, as the ulcer is very flat and is situated in two patients on the floor of the bladder, in the third it is extending widely over the great blood vessels.

At the present time, after two years the first cases of our second series of twenty-two cases, which had been given up by several surgeons and were treated by us according to our first imperfect technique, remain clinically cured. Several of them were again irradiated through the abdomen and the vagina two months and also six months afterwards.

We confess in all sincerity that we are astonished at the simplicity of the techniques and the favourable course of the post-operative recoveries. In the last cases the twofold operation was carried out within ten to fifteen minutes and several of these patients left the wards after three or four weeks.

I think that the study of the details of the operative techniques is nearly exhausted; the study of the suitable radium doses, and, if necessary, of the radium-X-ray doses, is at present our principal pre-occupation.

A NOTE ON THE PULMONARY VESSELS AND LYMPHATICS.

By W. OVEREND, M.D.

1. The employment of duplified films in conjunction with double intensifying screens—practically free from grain—has considerably facilitated and improved the quality of the work done by the radiologist. This is particularly apparent in pulmonary radiograms, because the time of exposure is now reducible to less than eight milliamperes-seconds. Moreover, with increased technical experience, these radio-films become superior to X-ray plates, both in contrast and structural detail. Consequently, the films are more easy of interpretation; in other words, the difficulties of differentiation between vessels, bronchi, etc., are proportionately diminished. It may, therefore, at this juncture, be profitable to review briefly the various opinions which have been expressed by radiological experts regarding the so-called *radio-structure* of the lung, and at the same time to submit a few radiograms in order to illustrate sundry points of essential importance.

Certain linear impressions, arborisations and diffuse mottling, have been attributed (a) to the walls of the bronchial tree; (b) to shadows cast by the

blood vessels and especially the arteries; (c) to opacities occasioned by thickened lymphatics presumed to be present in the early stages of tuberculosis, and *par excellence* in certain types of chronic fibroid and chronic minor phthisis; and finally, (d) to a summation of the positive shadows assigned to each system, and emphasised in disease by the incidental fibrosis of individual components.

2. It must be admitted that investigations carried out on the lung of the cadaver, by filling the bronchial tree or the vessels with contrast-material, and subsequent radiography, normal and stereoscopic, whilst useful in obtaining a general view of the topography of these entities, do not indeed lead to a satisfactory solution of the problem. Important facts, however, may be learnt by simply inflating the trachea and bronchi with air at different degrees of pressure. In radiograms produced in this manner the bronchi may be traced, as translucencies, far into the substance of the lung, and their walls are then seen to produce *no shadow whatever*. When the pressure of inflation is augmented, the transparencies or negative shadows exhibited by the more peripheral bronchi disappear, whilst *new linear opacities* come into view. Evidently the latter must be the radio-expression of small vessels still filled with blood; moreover, the smaller bronchi appear less visible *pari passu* as the alveoli become increasingly distended with air. Chaoul¹ infers, therefore, that the tracery of the normal lung, including the peculiar mottling, is largely a matter of vascular opacity. Where a double contour is seen on the film, the borders are not necessarily due to the bronchus; they may indicate the presence of vessels running parallel with it. In other cases the translucent band may be merely induced by contrast between vascular striæ and intervening tissue of the lung.

3. The above experiments naturally lead to investigations on the living subject under conditions of hyper-atmospheric pressure. At 20 cc. water-pressure, in deep inspiration, branching lines, which run centrifugally from the hilum *without any luminal negative shadows*, become more apparent. It seems reasonable to conclude that both in the hilum and in the lung the densities are, in the main, afforded by the blood vessels, and that future inquiry, with the help of increased atmospheric pressure, may become useful in the elucidation of some obscure lesions of the lung. It is obvious that a true explanation of the origin of these shadows, and an accurate orientation of the vessels and bronchi, is indispensable, if their pathological changes, as seen on the radiogram, are to be correctly interpreted: otherwise the presence of enlarged and diseased hilar glands may be diagnosed when the shadows are in reality due to transverse sections of normal or enlarged vessels; and peri-bronchial fibroid change may be assumed when the density is merely the manifestation of a bronchus with its accessory vessels.

4. The following deductions from the above statements appear justifiable: (a) the vascular densities should be more conspicuous during deep inspiration; also in the hypertrophic lung; in general emphysema, and in asthma, both during the attack and for some days subsequently; (b) they should be

more distinct in passive congestion of the lung (even if not accompanied by emphysema) as in mitral stenosis, also in general morbus cordis, especially if congenital, and in particular when serious failure of compensation is present ; (c) in the rare instances of pulmonary aneurysm and regurgitation ; (d) in general pulmonary vascular sclerosis and in the earlier stages of syphilis, in which a thickening of the pulmonary vessels is said to be a circumstance of frequent occurrence.

5. *The pulmonary curve or cap*, an opacity due to the stem of the pulmonary artery, is represented by the second prominence on the left side of the cardio-aortic shadow. At the inner edge its opacity blends with that of the base of the ascending aorta and renders the measurement of its calibre an impossibility. Enlargement of the cap, however, if accompanied by increased pulsation, signifies dilatation of the vessel. This occurs in some cases of tachycardia (personal observation) in passive congestion of the lung, in aneurysms of the artery,² in the majority of patients with congenital morbus cordis, such as deficient septum of the auricles, ventricles, or both, and stenosis of the pulmonary orifice. It was until recently taught that in congenital disease, dilatation and augmented pulsation of the pulmonary cap are the signs of a patent ductus arteriosus ; it is now known that these changes may occur in its absence.

6. *The right artery* runs transversely towards the hilum, just below the level of origin of the eparterial bronchus. It may be seen occasionally in right antero-lateral radiograms immediately below the arch of the aorta. It gives off two branches which approximate the eparterial bronchus. These arteries supply para-vertebral, mid-clavicular and axillary areas. The artery also sends off two branches, which reach the lateral parts of the chest below the deep axillary area, and may appropriately be termed the first and second lateral branches. The main trunk then runs through the hilum as a broadish band, outside the main bronchus, and about the level of the anterior osseous end of the fifth rib it breaks up into several branches ; one supplies the middle lobe, one is directed towards the costo-phrenic sulcus, others descend to the middle of the diaphragm, and one usually bends inwards and runs towards the right auricle and cardio-phrenic sulcus. The left pulmonary artery runs in front of the left bronchus, and describes an arch, which is more convex upwards and slightly higher than that of the right (*vide* Radiogram 2). From the convexity of the curve branches issue to supply the left upper lobe ; and the main vessel then gives off lateral and descending branches. According to the anatomical researches of Felix,³ the arteries and veins preserve a definite position with regard to the bronchi. In the upper lobe the arteries lie medial, in the middle lobe they run above, and in the lower lobe they are situated on the outer side, while the veins in each area occupy the opposite margin of the bronchi.

7. In a systematic research Assmann⁴ measured the width of the right hilar artery at a point just below the origin of the eparterial vessels, that is, about the level of the fourth rib. For this purpose he employed teleradiograms;

with the plate at a distance of 1.5 m. from the tube-target. The normal average breadth is 1.3 cm. Above 1.5 cm. the condition is abnormal. The calibre may reach 2.3 cm. in the passive congestion of mitral stenosis, uncompensated myocarditis, and in cardio-renal disease. But the greatest width is reached (3.2 cm.) in some cases of congenital morbus cordis. Naturally, it is not every teleradiogram which lends itself to measurement, and it is advisable to take previously an ordinary radiogram in one second or less at a distance of 24 in. for comparison. The presence of caseating or calcareous hilar glands, of hilar infiltrations—for example after influenza—vitiates the usefulness of the film or plate. But there are many instances where the vessel in this locality runs as a dark opacity, with even contours, and of the same calibre for a short distance—a condition which ensures an accurate estimation of its breadth. In all these cases of positive increase in the width of the hilar opacity there is also an augmentation in the dimensions and in the pulsation of the pulmonary cap.

8. *The right hilar pulse.*—Pulsation of the right hilum was first investigated by Schwarz, of Vienna, in 1910. He observed it in a case of mitral stenosis, one of mitral with aortic regurgitation, in one of emphysema; and ascribed its causation to the right hilar veins. The pulse is, however, best seen in congenital morbus cordis, and is accompanied by a greater calibre and pulsation of the pulmonary cap; it is, therefore, obviously due to the right pulmonary artery, the opacity of which is normally the essential constituent of the right hilar density.

9. *The lymphatic vessels and nodules.*—The lymphatic system within the lung consists of (1) a superficial or subpleural network, (2) a deep set of vessels divisible into three groups, which accompany the veins, the arteries and the bronchi respectively, (3) of numerous small accumulations of adenoid tissue situated in the vicinity of the bifurcation of the vessels and bronchi. Most anatomists now recognise the existence of free communication between the superficial and deep vessels. Pulmonary lesions, especially those of incipient tuberculosis, apparently are drained towards the hilum via the lymphatics, the latter thus protecting the parenchyma of the lung. When this route becomes unattainable the lymph seeks the hilar glands by way of the collateral lymph circulation, travelling along the septal trabecular vessels. The latter are provided with valves opening towards the subpleural lymphatics, the efferents of which run superficially towards the root of the lung (Miller, Dunham).⁵

10. The lymphatics and the nodules are best seen in certain cases of pneumoconiosis. The particles of dust entering the lung by inhalation become distributed through the peripheral lymphatic circulation and are slowly transported centrifugally towards the root and the bronchial glands. Jarvis⁶ has recently made an extensive radiological study of this disease as it occurs among the granite workers of Barre. The lymphatic nodules gradually enlarge, and for the sake of simplicity he divides them, in accordance with Dunham's three zones, into proximal or hilar, median, and distal or peripheral groups

(Fig. 1.). A proximal nodule is selected as the apex of a triangle, the angles at the base being occupied by two nodules of the median zone. One of the latter then constitutes the apex of a second triangle, the basal angles of which lie in the nodules of the peripheral zone. The sides of both triangles are formed by the lymphatic trunks. He also describes five stages in the evolution of the silicotic lung, viz., (a) increased width and opacity of the hilar shadow; (b) similar changes in the linear opacities, due to the passage of dust and the associated fibrosis; (c) the enlargement and increased density of the bifurcation nodules at the divisions of the vessels and bronchi; (d) the production of fans or cones as the result of imperfect drainage towards the hilar glands; and (e) the appearance of a peripheral homogeneous haze demonstrating a collateral drainage through the pleural lymphatics. Jarvis admits that the radiating shadows—best seen in the median zone—may be peri-vascular rather than peri-bronchial; since, in workmen formerly exposed to the influence of dust

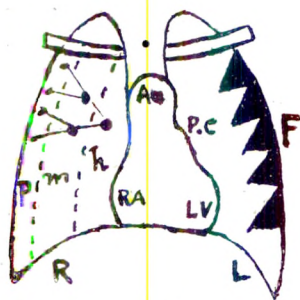
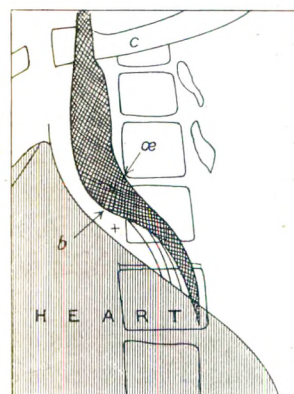


FIG. 1.—h, hilar zone; m, median zone; p, peripheral zone; F, fans in left lung; RA, right auricle; LV, left ventricle; Ao, aortic arch; PC, pulmonary cap (modified after Jarvis).

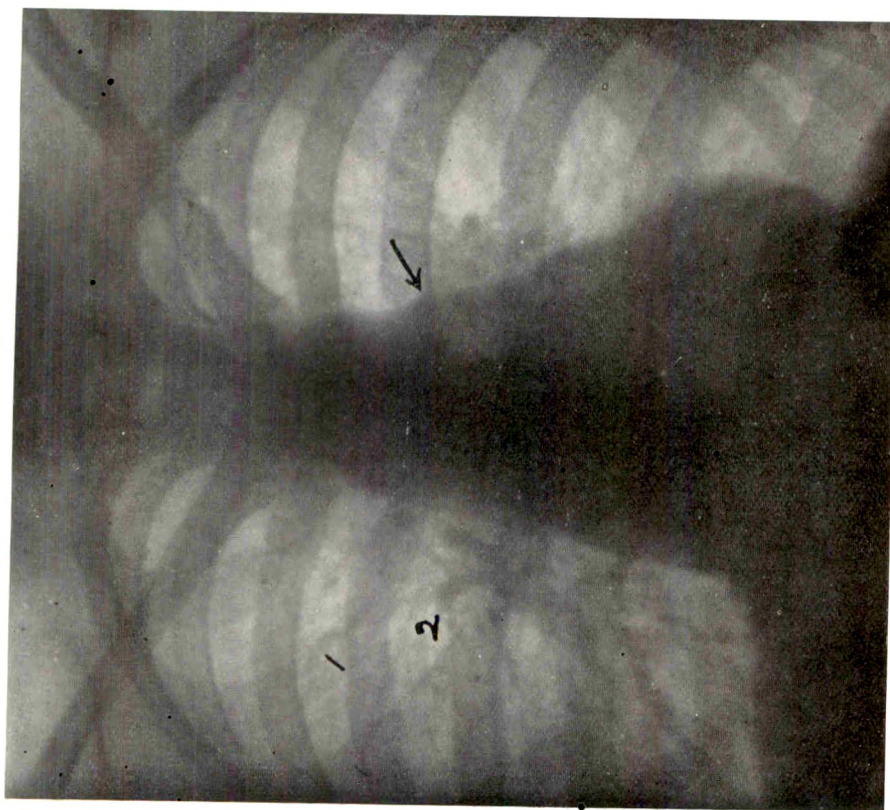


Left oblique diameter.

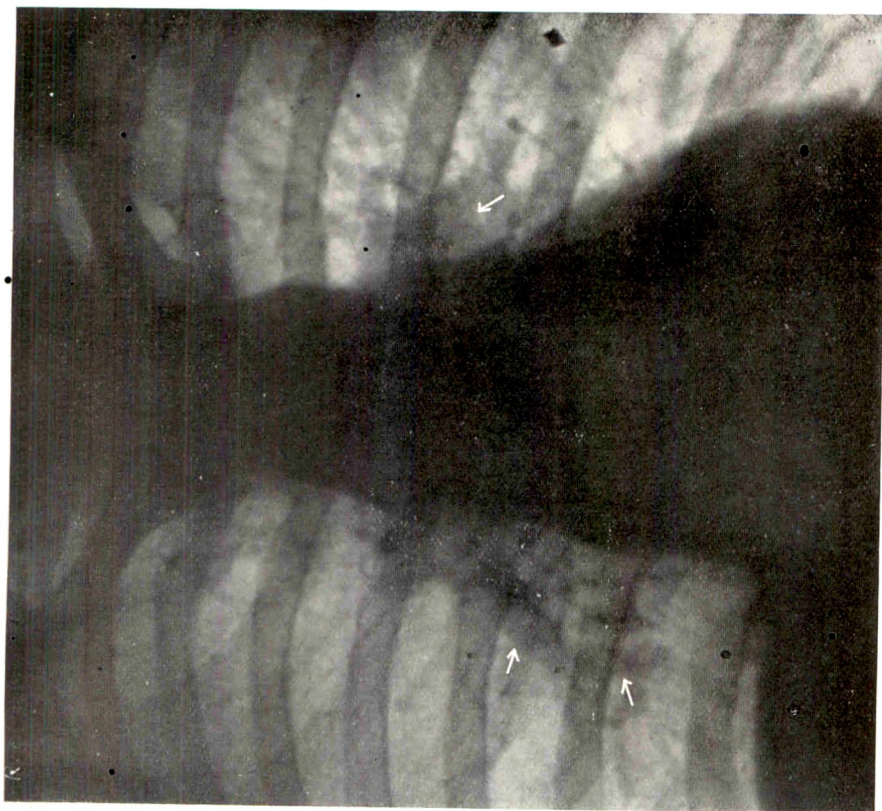
FIG. 2.—Left antero-lateral diameter of Radiogram 4; b, main bronchus; œ, oesophagus; c, clavicle.

for many years, and subsequently removed from its consequences for a period of five years, the bronchial twigs can be seen as areas of diminished density to the inner side of the markings. If the statement of Felix³—that in the upper lobes the veins run along the outer, and the arteries along the inner border of the bronchi—is corroborated, these opaque striae must represent altered peri-venous rather than peri-arterial lymphatic channels.

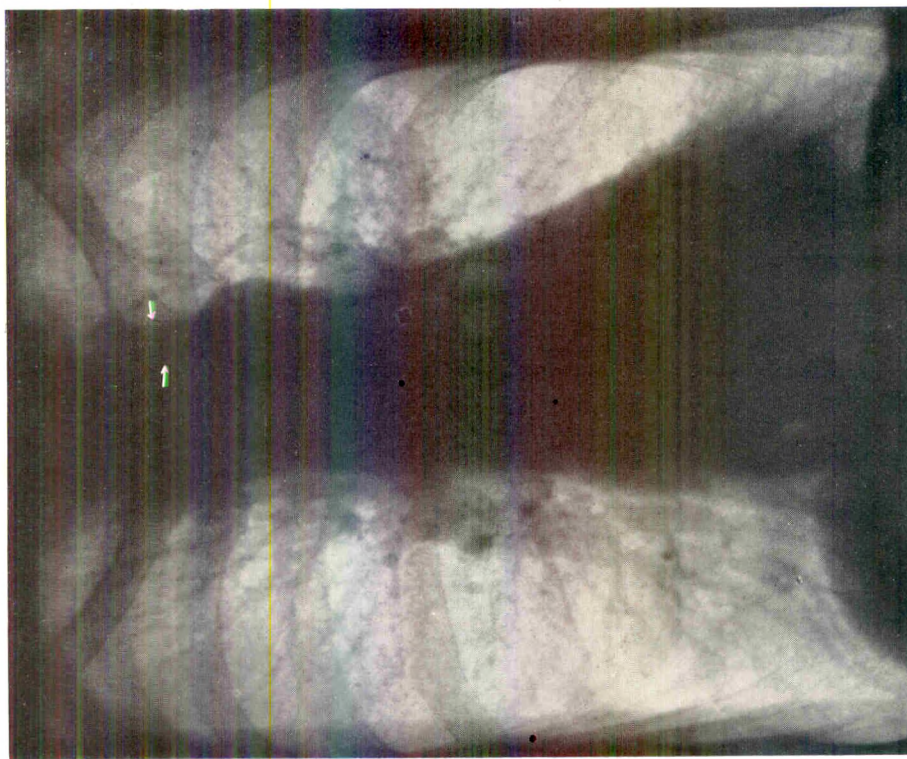
11. *Lymphangitis carcinomatosa*.—The supra-clavicular lymphatic glands (lower deep cervical) deserve particular attention on the part of the surgeon and radiologist, since they frequently become infected from the axillary glands after the removal of the breast for carcinoma. An internal group is situated behind the lower end of the internal jugular vein, immediately above the sterno-clavicular joint, and some of these lie directly on the cervical part of the parietal pleura which occupies the concavity of the first rib. The external group lies beneath the omohyoid muscle, close to the cords of the brachial plexus. Communications exist between the supra-clavicular and tracheo-bronchial glands. When the former become enlarged, as the result of



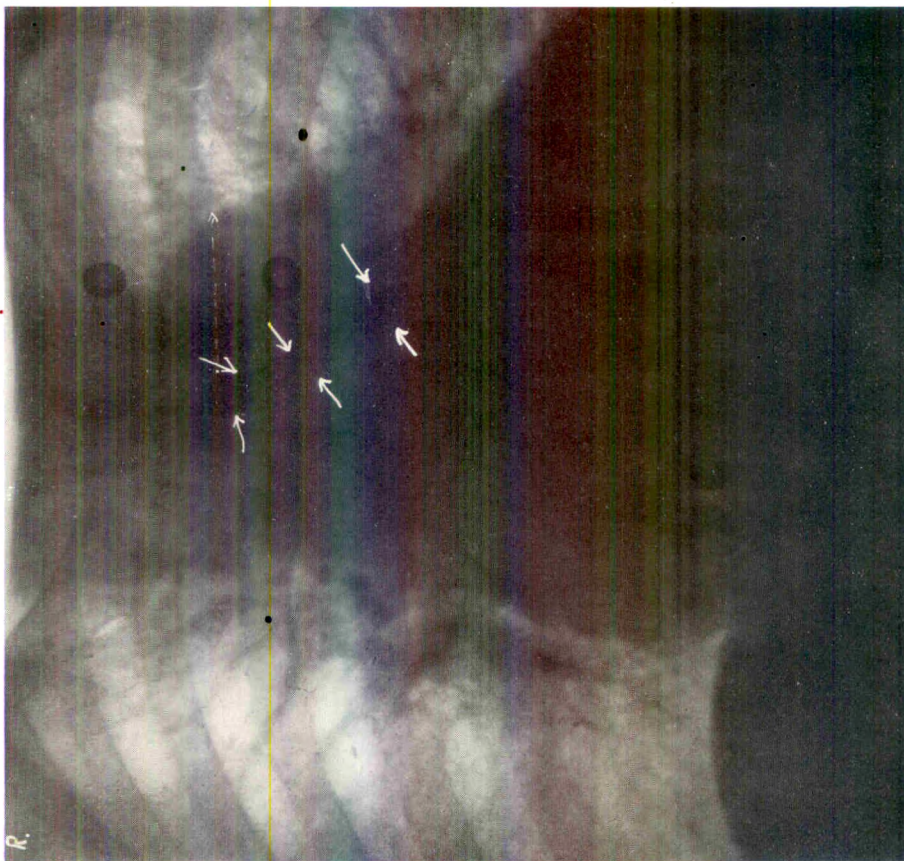
Rad. 1.—A. B. Aged 22 years. She has just recovered from an attack of influenza pneumonia; but owing to persistent dyspnea, slight pyrexia and tachycardia, it was thought there might be some delay in resolution. The only clinical pulmonary sign was a systolic murmur over the pulmonary cartilage. The radiogram shows no trace of pneumonic residue, but the pulmonary cap and left auricular appendage are conspicuous; also the right hilum and the vessels are more in evidence than normal. The arrows point to the first and second lateral vascular branches.



Rad. 2.—C. D. Aged 32 years. Contracted lungs 15 months ago. The radiogram exhibits a thickening of the vessels running down from the right hilum with a general vascular mottling of the pulmonary fields. The left hilar vessel is also more noticeable. These increased vascular opacities may prove useful in the diagnosis of pulmonary syphilis.

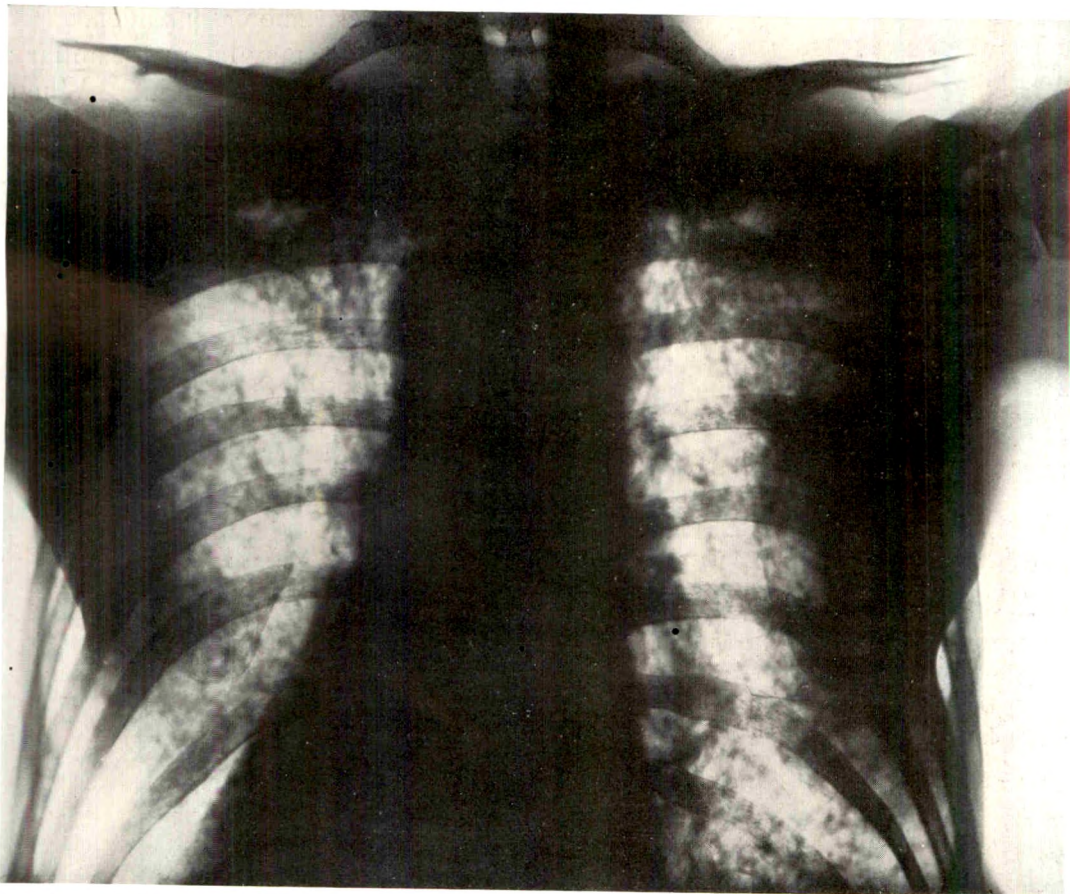


Rad. 3.—E. F. Aged 67 years. Both breasts were removed for carcinoma a few years ago. There is now a mass in the deep axilla on the right side. The radiogram displays the characteristic of senile emphysema, with marked arborisation of vessels throughout the lung (scleroses). At the root of neck the left subclavian artery is seen. Heart median: aortic cap enlarged. A few dark lines crossing the inner end of the right clavicle suggest the possibility of early infection of the pleura.



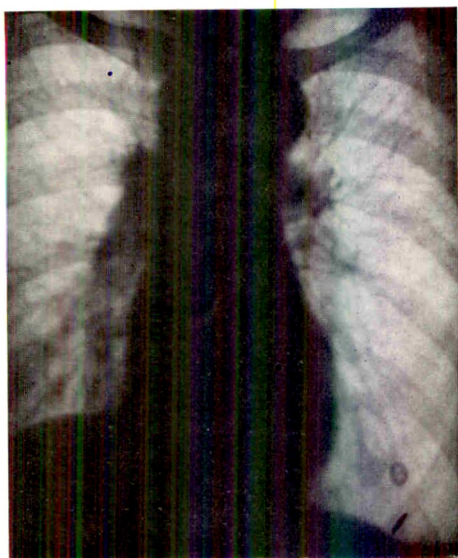
Rad. 4.—G. H. Aged 75 years. Clinical: dyspnoea, and occasional complaint of dysphagia. The radiogram indicates a dilated heart and aorta; also a deviation of the esophagus (bismuth) to the left. Incidentally, it shows a new method of measuring the calibre of the aortic arch (Kreuzfuchs, *Med. Klin.*, 1920, No. 2). In the left oblique view (Fig. 2) a displacement of the esophagus is also visible. The difficulty in deglutition appears to be due to pressure of the dilated left ventricle on the esophagus. In the radiogram the width of the right hilum is increased, and the vessels of the pulmonary field more manifest than usual.

Rad. 5.—L. M. Aged 60 years. With severe uncompensated morbus cordis and great dyspnoea. The hilar opacity and the shadows of the vessels are much enlarged.



Rad. 6.—(By permission of Dr. Hallam, of Sheffield). The radiogram is that of a workman who has been a tool grinder for thirty-five years (grit-stone). The lymphatic nodules are well seen; also there are indications of three peripheral fans on each side. The hilar opacities are enlarged and very dense. Emphysema.

carcinomatous metastasis, it is always advisable to radiograph the chest before deciding upon the appropriate form of treatment. The employment of mere fluoroscopy is futile. If dark radiating lines are seen on the film (Rad. 7) within the circle of the first rib, running in the direction of the hilum, the employment of deep therapy in addition to radium is indicated. These striae appear to be lymphatics of the pleura filled with carcinomatous debris. The



Rad. 7.—N. O. Aged 61 years. Had one breast removed for carcinoma several years ago; now has enlarged axillary and supra-clavicular glands on both sides. The radiogram shows lymphangitis carcinomatosa in the cervical pleura, and enlarged opacities in both hila, with some dissemination towards the right base. Clinical: much local thoracic pain with dyspnoea and some wasting.

presence of pleuritic adhesions is believed to hinder dissemination in this direction (Handley)—a conception which should be capable of verification by radiography.

12. In bronchial carcinoma similar lines radiate from the shadow of the tumour, and are due to infection of the pulmonary or pleural lymphatics. In the later stages of hepatic and gastric carcinoma the lung may become permeated by numerous small opaque foci, similar to those of pneumoconiosis and miliary tubercle. These may be produced by a carcinomatous adenitis of the small nodules, or may be a pure miliary carcinomatosis of vascular origin. When branching linear shadows are present, in addition to the small opacities, the lesion is lymphangitis carcinomatosa (although some of the foci may merely be cross-sections of vessels); if no ramifications are visible at all, it is probably a genuine miliary carcinomatosis; whereas, if no nodules are perceptible, and the film shows

radiating lines only, a pure dissemination along the lymphatics of the pleura may be responsible.

REFERENCES.

- (1) Chaoul, "Untersuchungen über die Frage der Lungenzeichnung," *Deut. Zeitschrift für Chirurgie*, Bd. 152.
- (2) Taft, "Pulmonary Aneurysm," *American Journal of Rontgenology*, Feb., 1920.
- (3) Felix, "Chirurgie der Brustorgane," *Sauerbruch*, 1920.
- (4) "The Hilar Opacity in Morbus Cordis," *Munchener Med. W.*, 1920, No. 7.
- (5) Dunham, "The Cone and Collateral Circulation," *American Review of Tuberculosis*, 1917.
- (6) Jarvis, *American Journal of Rontgenology*, May and Oct., 1921.

RADIOGRAPHY IN ITS RELATION TO MINERS' PHTHISIS ON THE WITWATERSRAND.

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Owing to the heavy mortality from silicosis among miners in the Witwatersrand area in past years, public attention became more and more focused on the disease, with the result that, in 1916, a Miners' Phthisis Medical Bureau was established at Johannesburg under Government auspices. This organisation is intended to minimise, as far as possible, the harmful effects produced on underground workers on the reef. This it does by preventing physically unfit men from taking up mining, and by detecting the disease in its earliest form among those in employment.

The Bureau comprises a Chairman, nine whole-time Medical Officers, and a Medical Radiographer; it is their function to examine all candidates for underground work on scheduled mines, all regular workers every six months, and all applicants for compensation. These three classes of examinee are known as "initial," "periodical," and "benefits," respectively.

The routine for each class includes a rigid and thorough clinical examination and a standardised radiographic investigation.

Independent reports of the clinical and X-ray findings are submitted in each case; these are considered by all the members of the Bureau, and every factor in the complex is duly weighed and its value apportioned to it before a decision is arrived at. This tribunal decides: 1, whether an applicant may become an underground worker; 2, whether a miner may continue working underground; and 3, in the case of a man who has incurred disability from silicosis, its extent and degree of permanence, with a view to indicating the appropriate compensation.

As the examination of the thorax is one of the most successful applications of X-ray diagnostic methods, it is natural that it should hold a high place in the general summation of a mine-worker's condition; it is the object of this paper to deal more particularly with this side of the question in the light of the experience accumulated during the past nine years.

Before proceeding further it will not be altogether inappropriate to say a few words regarding the system of identification which is followed. Every individual examined has a serial number assigned to him; this particular number is never altered, and is recorded upon all skiagraphs and documents relating to the individual. Upon presenting himself at the office of the Bureau the man writes his name upon a slip of thin card, which also carries his number and the date. This slip he brings with him into the X-ray room. He is now photographed whilst sitting in a fixed chair before a camera of fixed focus. This camera is a double one, and photographs simultaneously upon the same film the head and shoulders of the man and his signed slip. In this way a

signed and dated photograph of the man is produced, and this is pasted on to the back of the certificate issued with respect to the examination. A radiograph of the chest is next prepared.

Criticism has been levelled at the Bureau on the score that the X-ray examination is incomplete, inasmuch as no screening is undertaken. The screen certainly affords very valuable information, more especially as regards the movement of the diaphragm and the differentiation of aneurism from tumour; but, taking into consideration the danger to the operator from continual screening, and the expenditure of time involved, it was thought advisable to delete this adjunct to diagnosis when dealing with large numbers of cases.

Skiagraphs are taken as far as possible under identical conditions; the subject, stripped to the waist, lies in the prone position upon the film, with the tube above; the position of the anticathode relative to the film is constant, and the distance between them is $24\frac{1}{2}$ in. (62.2 mm.). Automatic guides ensure the correct position of the examinee, and the only variable factors are the antero-posterior diameter, or thickness, of various men's chests, and the hardness of the tube. These are compensated for by adjusting the internal resistance of the tube and varying the length of the exposure.

The thickness of the chest is quickly ascertained by a graduated L-shaped rod attached to the tube box. This thickness, in the great majority of cases, falls between $7\frac{1}{2}$ in. and $8\frac{1}{2}$ in. (19.0 and 21.5 cm.), the extremes hitherto encountered being 6 in. and 13 in. (15.24 and 33.0 cm.). The shallow chest naturally gives a skiagraph showing good detail, whereas a certain amount is lost by scattered radiation in heavily built individuals. Experiments with a Potter-Bucky diaphragm have shown us that the defect due to scattered radiation can, to a large extent, be overcome, and it is probable that a modification of this apparatus suitable to our requirements will shortly be obtained.

The internal resistance of the tube, *i.e.*, its hardness, is determined by ascertaining the amount of current which will pass through it when using the lowest stop. This method may appear to be rather haphazard, but in practice it gives results quite as satisfactory as those obtained by other methods.

Eight-inch, tungsten target, fine focus, gas tubes are used, as it has been found, after many comparative experiments, that these appear to give better results than the Coolidge. The latter is certainly more flexible and more easily controlled than the gas tube, and it is possible that in conjunction with the Potter-Buckey diaphragm it may give as good or better results.

An interrupterless transformer set, which is duplicated to obviate delays during repairs, is used to obtain the current for exciting the tube. Some 60 milliamperes pass through the tube during the exposures; the length of the latter is automatically controlled and varies from $\frac{1}{2}$ to 2 seconds, being in the great majority of instances $\frac{3}{4}$ of a second. 12 in. by 10 in. duplitised films are employed; these, though rather small for complete skiagraphs of the thorax, have been adopted for reasons of economy, and it is very seldom that any doubt is raised, or any point missed, on account of the skiagraph not being sufficiently large.

All skiagraphs are taken during full inspiration; better contrasts are obtained, and it appears to be easier for the subject to refrain from all respiratory movement when the chest is in this position than in any other. When the operator is ready to make the exposure he closes a foot switch, thus giving a bell signal to the examinee, who takes a deep breath and holds it. Whilst the thorax is inflated the operator presses a button, thereby energising a relay which closes the main circuit for the requisite time.

Immediately after the exposure has been made, the man's number, classification (whether initial, periodical or beneficiary), and the date of the examination, are recorded on the area of the heart-shadow by a second exposure of an eighth of a second beneath an adjustable stencil-plate; in this way all details necessary for identifying the radiograph are automatically and indelibly recorded upon it.

The films are placed in holders and are developed in batches of six; after thorough washing, the holders carrying the films are transferred to a series of viewing stands, capable of simultaneously exhibiting one hundred and fifty skiagraphs.

Miners' phthisis* is caused by the inhalation of fine particles of siliceous dust over a long period. It appears to be essential that the dust shall contain free silica; silicates, by themselves, are relatively innocuous. Some of the dust is conveyed by wandering cells into the peri-bronchiolar tissues, in which position the lymphatic system speedily finds itself unable to cope with their removal. These cells now become transformed into fibroblasts, and thus a fibrosis is initiated which becomes more extensive as time goes on. The supervention of an infective process, especially tubercle, greatly accelerates the development of fibrosis, and eventually, owing to the obliteration of alveoli, bronchioles, and capillaries, the lungs become unable adequately to oxygenate the blood.

These changes can be clearly followed in a series of skiagraphs of any particular case, and the appearances are so striking and specific that a single glance at the plate of a victim is usually sufficient to enable one mentally to visualise the exact changes in the lungs. Confidence in interpretation has been secured by post-mortem investigations. The organisation of the Bureau is such that necropsies are obtained in the great majority of all fatal cases, and in these the radiographs taken during life are always compared with the appearances in the lungs after death. For the last three years the annual average of post-mortem examinations of lungs has exceeded 450.

In appraising a man's pulmonary condition from his skiagraph, attention is centred on the shadows of the heart and aorta and on the adventitious shadows. It is not necessary to describe the normal shape and size of the heart-shadow; departures from the normal are fairly frequent, the outline varying from that of a narrow, vertical cylinder, found chiefly in tuberculous and weakly subjects, to that of a large pyramidal mass, found in the large and obese.

* The terms "Miners' Phthisis" and "Silicosis" are held by the law of South Africa to mean one and the same disease.

The discovery of a "vertical," or "asthenic," heart (Figs. 3 and 7) in the skiagraph of an initial candidate is enough by itself to cause the Bureau to reject him for employment as a miner. Such cases are almost invariably under weight, but no explanation of the abnormality in the shape of the heart-shadow has as yet received general acceptance. The idea was put forward that the vertical heart was part and parcel of a general visceroptosis. All cases that showed the abnormality were accordingly examined for gastropptosis, and though the latter was found in some instances, the association was by no means general. A suggestion that it was due to a sub-normal blood pressure was negatived by investigation. The theory that it is the result of a chronic toxæmia has not found support from the examinations carried out, as many of the subjects showed no other abnormality. The Chairman of the Bureau considers that the contraction and change in outline which characterise the "vertical" heart are merely the result of cardiac atrophy, from whatever cause this may have arisen; since the shrunken organ is no longer capable of filling the pyramidal serous sac provided for it, the sides of the sac, especially towards its base, are deprived of their internal support and tend to be displaced, centripetally, inwards. Whatever be the explanation of the phenomenon; it is certain that such individuals, when working underground, are more prone to develop silicosis, and/or pulmonary tuberculosis, than are other miners.

As would be expected, the initial examinees are fairly uniform as regards the amount of fibrosis detectable in their lungs, but, curiously enough, what was accepted at the outset as the "normal thorax" (Fig. 1) has proved to be exceptional—the great majority having to be classed as "rather more fibrosis than normal" (Fig. 2)—due, as a rule, to peri-bronchial thickening, or increased fibrosis in the root areas. Occasionally a negative is encountered which shows so little pulmonary shadow that a report of "less fibrosis than normal" has to be given; but such cases are very rare.

Five or six instances have occurred amongst 19,200 initial examinees who had never been underground, in which a form of fibrosis closely simulating if not identical with that due to quartz inhalation has been disclosed; it is indeed probable that the mode of life in each instance entailed unusual exposure to siliceous dust, whether in the form of dust-storms or otherwise. One such case had been a transport rider, leading all his life in the open; one had been a steward on the Rhodesian mail train for several years; one had been a farmer on the high veld; one had been employed for many years, upon the surface, as a drill sharpener—the drills, when brought up for sharpening, are covered with quartz mud which, when the drill is heated in the forge fire and hammered on the anvil, is liberated in the form of dust; one had been a brick maker, and it was found that he had long been accustomed to dust out his moulds with the very fine sand obtained by drying the "slimes" from a mine battery.

Turning now to the group of periodical examinees, that is, the miners who have to be examined every six months. The bulk of their films are diagnosed

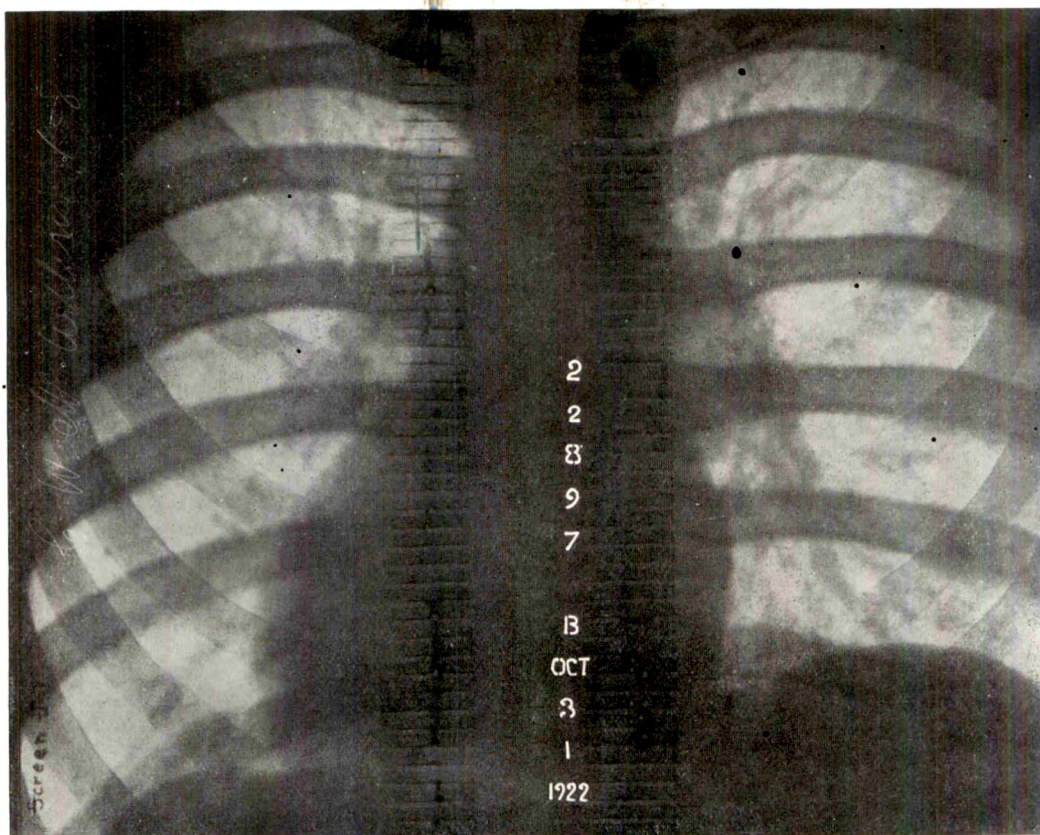


FIG. 1 (22897).—Typically “normal thorax” in adult male European on the Rand. The bronchial tree is definitely outlined and there is evidence of some degree of adventitious, though “normal,” fibrosis in the root areas.

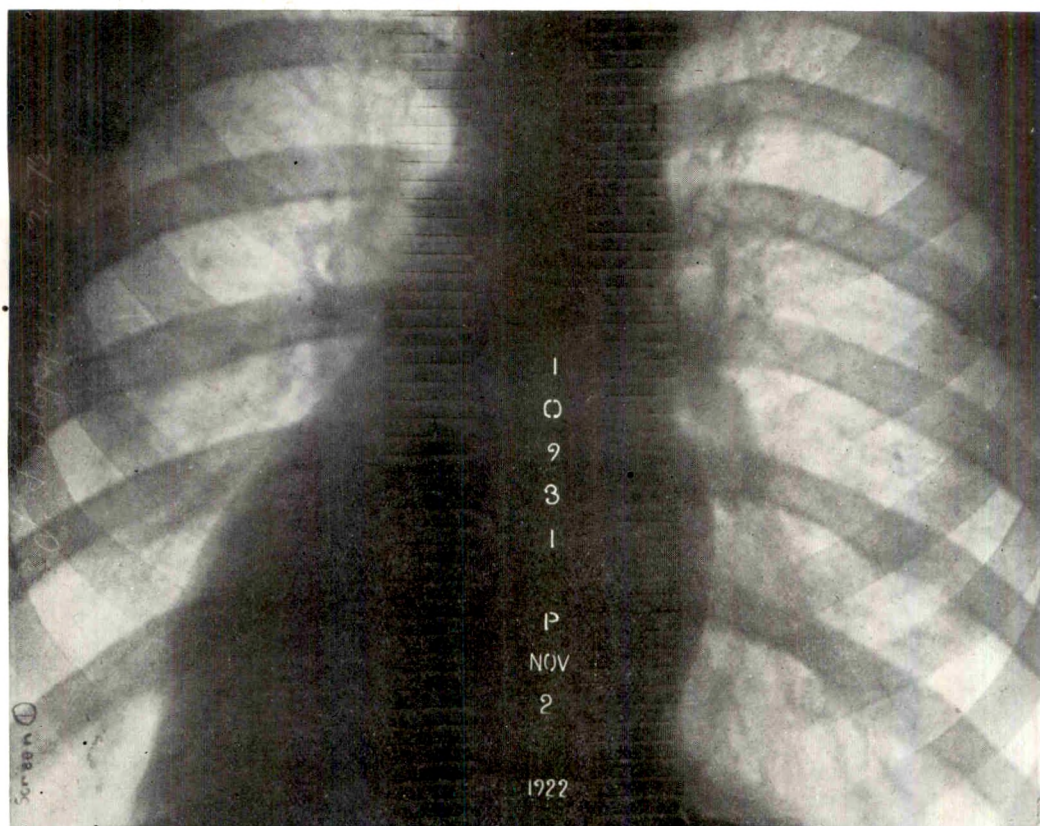


FIG. 2 (10931).—“Rather more fibrosis than usual.” Much the same as previous Fig., but there is an accentuation of the bronchial shadows and of those in the root areas.

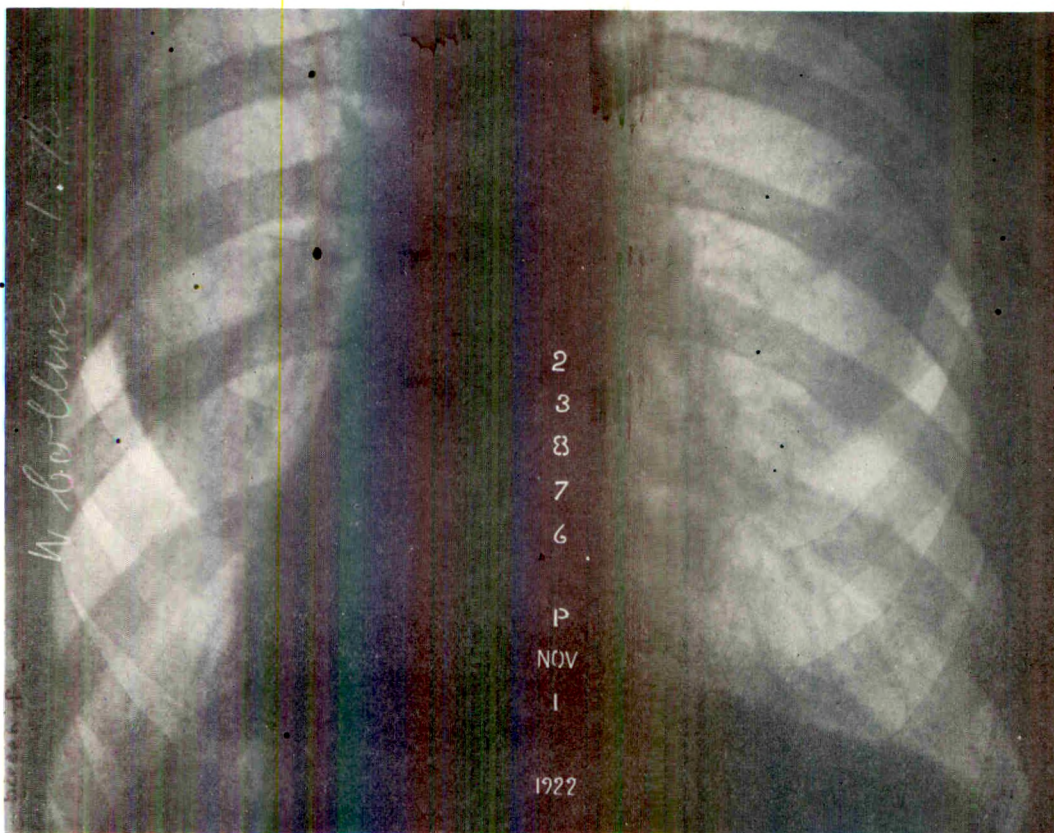


FIG. 3 (23876).—The “vertical” type of heart. This appearance is an insuperable bar to the acceptance of a candidate as a new miner.

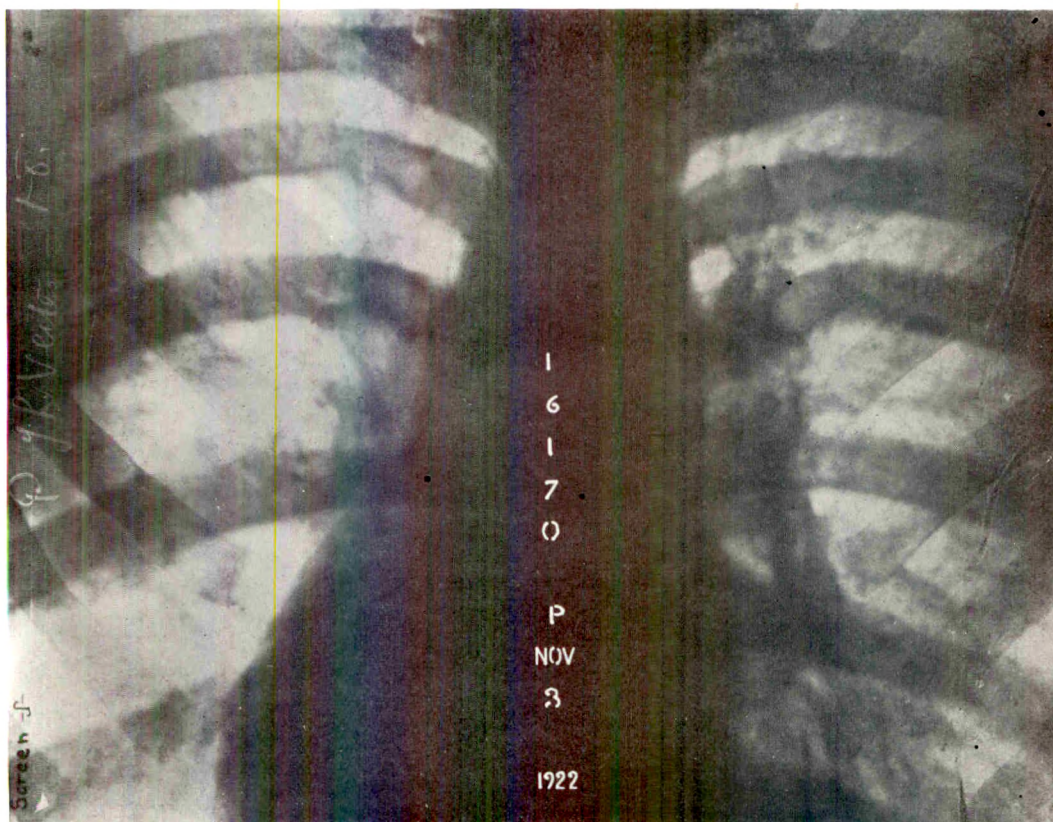


FIG. 4 (16170).—“More fibrosis than usual.” A further accentuation of the bronchial shadows, with the appearance of a coarsely reticular formation between them.

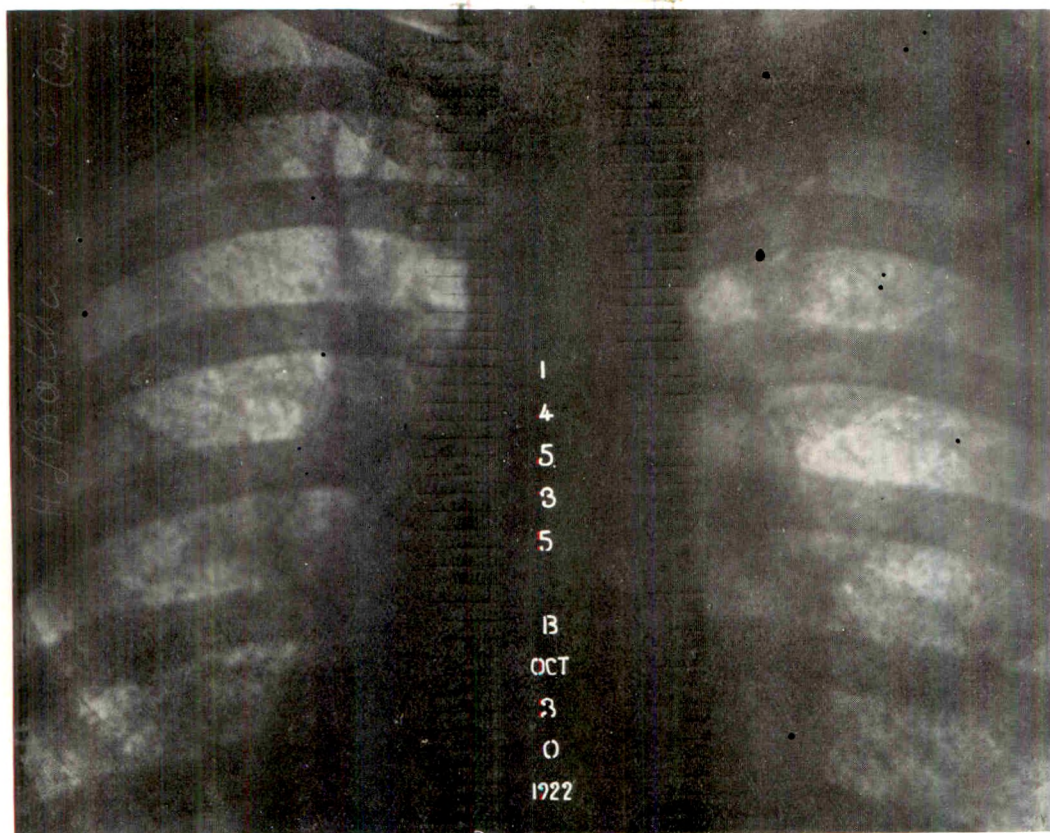


FIG. 5 (14535).—"Commencing silicotic fibrosis." The earliest specific radiographic sign of silicosis. The reticular formation has given place to a miliary one.

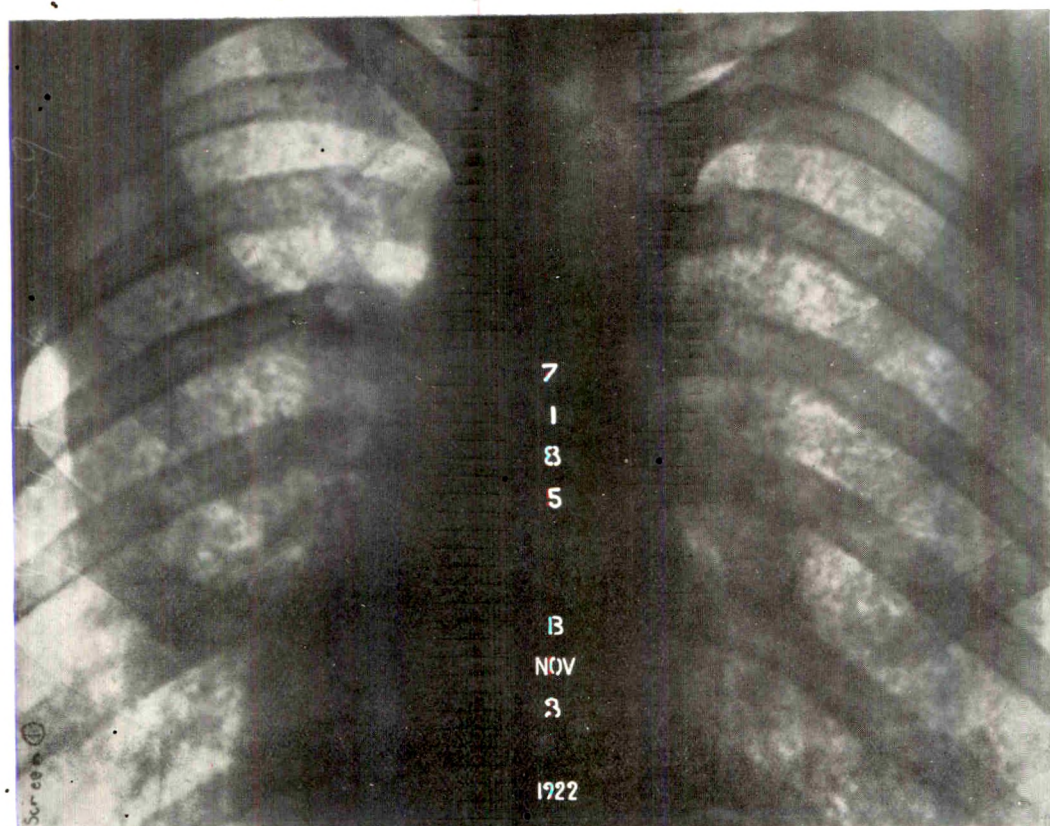


FIG. 6 (7185).—"Early silicosis." The nodular fibrosis has become coarser in character, and the individual nodules less numerous.

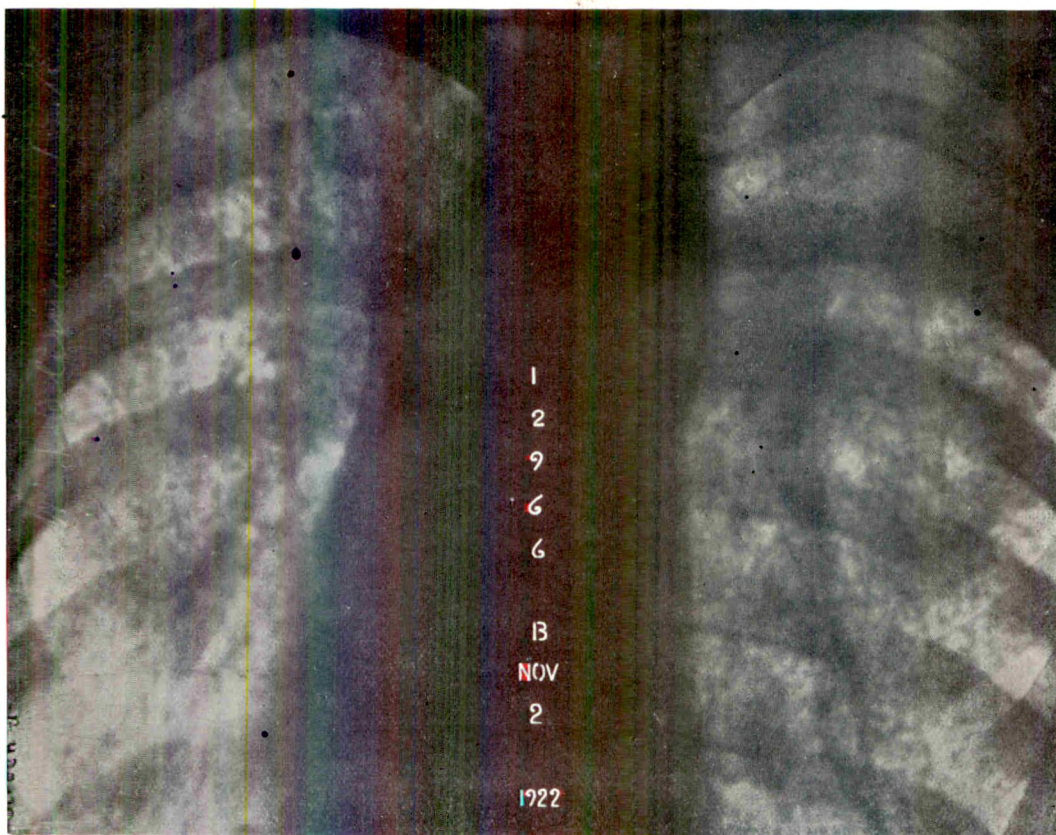


FIG. 7 (P2966).—"Early silicosis complicated by tuberculosis." The silicotic fibrosis has developed to about the same degree as in Fig. 6, but the appearance of incipient "clouds" in both lungs indicates the presence of early tuberculous changes. The heart-shadow has become "vertical" in appearance.

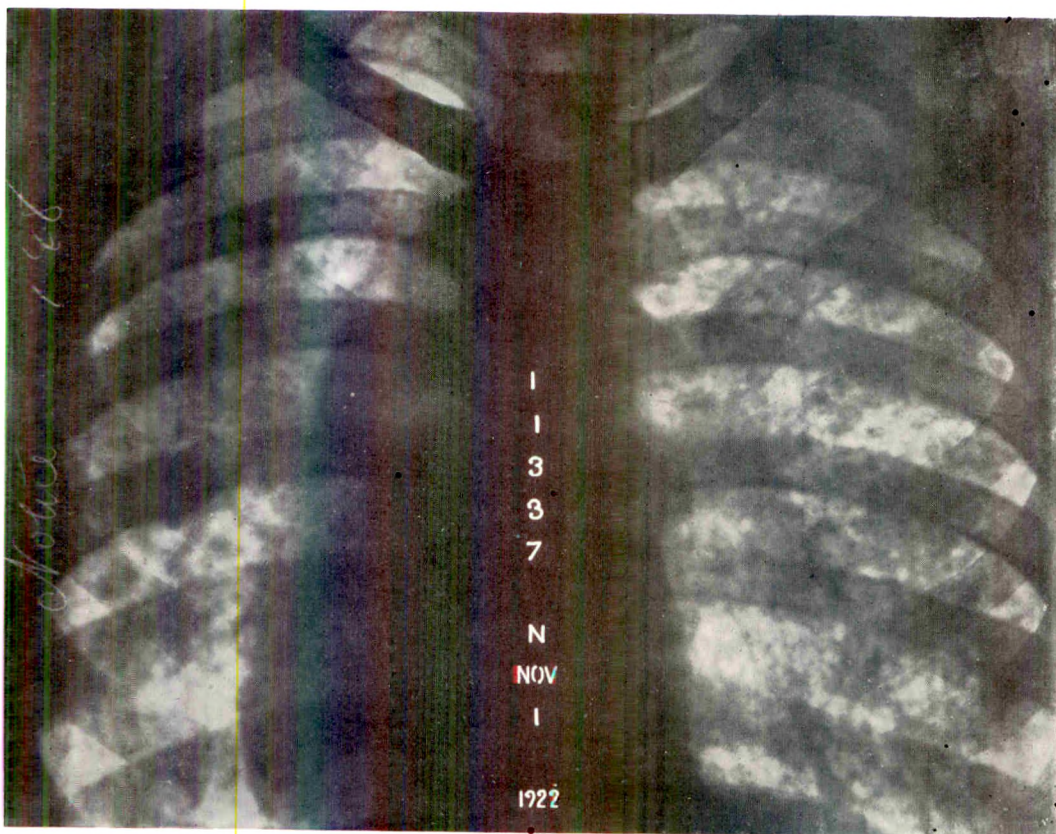


FIG. 8 (11337).—"Medium to advanced silicosis." The nodular fibrosis is of coarse type. The outlines of the individual nodules tend to be ill defined and to coalesce into "flocculi," appearances which are indicative of tuberculous complication.

as "more fibrosis than usual" (Fig. 4); here and there a negative showing the definite commencement of silicosis is to be seen, or which suggests the onset of tuberculous mischief. In the latter case the man is put under special observation in the Bureau ward; his sputum is repeatedly examined, and his temperature taken four-hourly. If the diagnosis of tuberculosis is established, the man's certificate of being fit for underground service is withdrawn, and he is compensated and compulsorily retired.

Syphilitic fibrosis is not common, but has been encountered on two or three occasions. Its appearances have no resemblance to those of silicotic fibrosis, but are very liable to be mistaken for the tuberculous form; the subjects, however, are generally up to weight, look robust, and do not present the "asthenic" or "vertical" type of heart. The Wassermann reaction is ascertained when this condition is suspected, and if it is positive, specific treatment is instituted, with the result that the fibrosis speedily clears up.

Negatives showing well marked silicotic fibrosis often appear amongst the "periodicals," for a miner is not compelled to give up his work merely on account of simple silicosis, but only when tuberculosis supervenes.

The various stages of silicosis are differenced, by the Bureau, in accordance with their legal definitions, and therefore, in the main, by the amount and degree of permanency of the incapacitation of the worker. These legal stages are paralleled by the indications of the radiograph in the majority, but by no means all, of the cases. In other words, the stages, as diagnosed by clinical or by radiographic means alone, do not necessarily correspond. Notwithstanding this fact it is necessary, in order to facilitate reference and discussion, to classify the radiographic appearances of the disease in various "stages." These radiographic stages are illustrated by a standard series of radiographs, which are permanently displayed in the meeting-room of the Bureau. The negatives illustrating these standard stages have been selected from a very extended series of cases, and their interpretations have been, in almost all instances, verified by post-mortem examination.

The first indication of change to be detected in the skiagraph of a miner who is developing silicosis is due to the formation of fibrous tissue; this leads to the accentuation of the hilus and larger bronchial shadows. These shadows gradually become denser, and further fibrosis brings out the shadows of the smaller tubes, so that, in time, a linear network of shadows appears throughout both lungs, more marked, as a rule, towards the right base. So far, the appearances are not pathognomonic of silicosis, and it is not until the super-vention of the appearances next described that a definite diagnosis becomes possible.

The next "stage" (Fig. 5) is the apparent segmentation of the linear shadows, which now present themselves as numerous, small, discrete but closely aggregated miliary nodules, the change from reticulation to nodulation usually progressing uniformly throughout the whole of both lungs. As the disease advances, the nodular shadows, as seen in serial skiagraphs, grow in size but decrease in apparent number (Figs. 6 and 7). The shadows of the

nodules are clearly and sharply cut, as long as the condition remains one of simple silicosis; but if tuberculosis supervenes, the shadows in the area attacked lose this characteristic, become larger, and develop ill-defined edges (Fig. 8).

The grosser indication of the supervention of a tuberculous complication is the appearance of one or more areas of "clouding" in the hitherto uniformly mottled lung shadow (Fig. 7). These clouded areas are, at first, usually unilateral, and if they appear in both lungs they are usually unsymmetrical.

The heart-shadow in silicosis tends to become more and more "vertical," but not to the same extent as in simple tuberculosis.

The factors which enter into the development of silicosis are: Duration of exposure to its cause, type of work, type of man, character of habits, and secondary infections of the damaged lungs.

The work of the Bureau gives its members unique facilities for studying the origin and progress of silicosis, and for recognising pulmonary tuberculosis in its earliest detectable stage. In addition to this, opportunities have arisen for the diagnosis and verification of practically every type of thoracic abnormality. Over 200,000 radiographs are now filed in the Bureau, together with the medical dossiers of the 45,600 Europeans and 11,500 natives to whom the radiographs refer. Two cases of dextrocardia have been encountered among the Europeans.

I am indebted to Dr. W. Watkins-Pitchford, Chairman of the Bureau, for permission to publish this paper, and for assistance in compiling it. It is not too much to say that the occurrence of even the slightest hitch in any department of the Bureau is almost unknown; this is due to the personal consideration given by Dr. Pitchford to every detail of the elaborate organisation, entirely of his design, by which the Bureau fulfils its functions with smoothness and efficiency.

ACTA RADIOLOGICA.

Published by the Societies for Medical Radiology in Denmark, Finland, Norway and Sweden.

Editor: GÖSTA FORSSELL, M.D., Stockholm.

The following are the authors' abstracts of the articles of No. 3, Vol. I, 10th April, 1922:—

A Peculiar Characteristic Metatarsal Disease.—H. J. PANNER, Copenhagen (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 319-333).—A metatarsal disease arising during the period of growth (at the age of 10-14) is found, which almost always is localised to the second metatarsal.

The disease falls into the category of diseases to which belong Calvé-Perthes's hip disease,

Köhler's disease in os naviculare pedis, Schlatter's disease in the tuberositas tibiae, and the spinal disease described by Scheuermann.

The primary starting point is the capitulum metatarsi, that is, as in the other cases, in an epiphysis; secondarily, arthritis deformans-like alterations may appear in the joint as well as thickenings of the diaphysis; often the last stage is, however, only a more or less

marked deformation of the head of the joint itself.

The progress of the disease is mild, the symptoms not infrequently so slight as to be left quite unheeded, and a thorough treatment is but seldom necessary.

The changes are, therefore, not infrequently found only by an accidental roentgen examination, and the latter gives (as is also the case in the above-mentioned disease) such characteristic pictures that the diagnosis will thereby be established.

Blood Changes by Roentgen and Radium Treatments.—AXEL WESTMAN, Stockholm (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 349-357).—The author has studied the blood changes in patients treated by roentgen and radium. In both cases the changes are absolutely identical, only varying in strength according to the intensity of the irradiation. The changes of the red corpuscles are characterised by a slight increase in the number of erythrocytes as well as in the quantity of hemoglobin and the globular value, which are very differently expressed in the different patients, and which persist for a more or less lengthy period.

No certain conclusions can be drawn from these changes; they do not appear to be able to give any aid towards forming a prognosis. The changes of the white corpuscles are much more pronounced. After a few weak doses, corresponding approximately to a treatment for castration, an initial increase is obtained in the leucocyte count, caused by the neutrophile polynuclears, and on the fourth to sixth day a decrease in the leucocytes occurs, followed by a slow retrogression towards the initial values. The leucocyte count remains constant. The changes in the blood, after the irradiation of tumours, belong to another type. By means of curves, it is shown how, after the irradiation by radium of uterine cancer, a transient increase of leucocytes is at first obtained, and finally a decrease in the polynuclears and the leucocytes. At the end of but a few months the blood picture has returned to its normal value. In the case of irradiations of mammary cancer after the operation, where there is no secondary toxic

effect from the reabsorbed tumours, the initial increase of the leucocytes does not take place. The changes in the eosinophile blood picture are attributed to a secondary toxic action proceeding from the tumescent reabsorption. The cases favourably influenced by the radiological treatment show much less marked blood changes immediately after the irradiations and a much more rapid repair, especially of the lymphocytes, than for the refractory cases. Consequently, the examinations of the blood may serve as a guide in respect to the prognosis.

Treatment of Malignant Tumours with Radium Needles.—S. A. HEYERDAHL, Christiania (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 358-365).—The previous favourable results of the treatment of malignant tumours with radium embedded in needles confirm what has also been experienced from other quarters. Embedded in the tissue of the tumour, the radium exercises throughout a much greater influence on the tumour than when applied on the outside, and it is also much more lenient towards the surrounding healthy tissue.

Tumours which had formerly been treated on the outside with radium, without any result, vanished after the embedment of radium in the tissue of the tumour.

As these observations have been made in rather a short time, they must, of course, be considered as quite preliminary.

The Treatment of Myoma Uteri and Menorrhagia with Radium and Roentgen Rays.—S. A. HEYERDAHL, Christiania (*Acta Radiologica*, Vol. I, Fasc. 3, pp. 366-371).—Of thirty patients suffering from myoma uteri, twenty-five were exclusively treated with roentgen rays, and five were given combined roentgen and radium treatment.

In twenty-five cases a good result was obtained: cessation of the menses together with complete or partial disappearance of myoma in most cases. Five patients were operated after the roentgen treatment. Of thirteen patients suffering from menorrhagia, twelve cases attained to a complete cessation of the menses. In one case there was a recurrence and later on an operation.

PUBLICATIONS RECEIVED.

Books.

The Duff House Papers. Vol. I. Edited by E. I. SPRIGGS, M.D., F.R.C.P. (Oxford Medical Publications, 30s. net.)

Journals.

Archives d'Électricité Médicale et de Physiothérapie, December, 1922; January, 1923.

Archives de Médecine et de Pharmacie Militaires, September, 1922.

Archivio Italiano di Chirurgia, December, 1922. Parts IV. and V.

British Journal of Dermatology and Syphilis, February, 1923.

Bulletin of the Johns Hopkins Hospital, January, 1923.

Bulletins et Memoires de la Société de Radiologie, January, 1923.

La Chirurgia degli Organi di Movimento, January, 1923.

Electricidad Médica, December, 1922.

Health, February, 1923.

Hospitalstidende, January 3rd, 10th, 17th, 1923.

International Journal of Orthodontia, January, 1923.

Journal of Laryngology and Otology, February, 1923.

Journal de Médecine de Bordeaux, January 25th, February 10th, 1923.

Journal de Médecine de Lyon, January 5th, 20th, February 5th, 1923.

Journals—continued.

Journal of Radiology, January, February, 1923.

Journal de Radiologie et d'Electrologie, December, 1922; January, 1923.

Kongresszentralblatt für die Gesamte Innere Medizin und Ihre Grenzgebiete, January 15th, 22nd, 29th, February 5th, 12th, 1923.

Medical Journal of Australia, December 2nd, 9th, 16th, 23rd, 30th, 1922; January 6th, 1923.

Medical Science, February, 1923.

New York Medical Journal and Medical Record, January 17th, February 7th, 1923.

New York State Journal of Medicine, January, 1923.

Norsk Magazin for Lægevidenskaben, January, 1923.

Il Policlinico, January 1st, 15th, February 1st, 1923.

Proceedings of the Royal Society of Medicine, February, 1923.

Quarterly Journal of Medicine, January, 1923.

Radiologia Medica, January, 1923.

Revue de Stomatologie, December, 1922; January, 1923.

Röntgenologia.

Strahlentherapeutische Monographien. Pts. I, II, III.

Ugeskrift for Læger, February 8th, 1923.

Urologic and Cutaneous Review, January, February, 1923.

NOTICES.

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ARCHIVES OF RADIOLOGY AND ELECTROTHERAPY

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A list of collaborators at home and abroad is being prepared and will be published at an early date. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

THE ASSOCIATION OF THE SURGEON AND RADIOLOGIST IN BONE GRAFTING.

By ST. J. D. BUXTON, M.B., B.S. London, F.R.C.S. England.

Assistant Surgeon and Assistant Orthopædic Surgeon, King's College Hospital.

RADIOGRAPHY IN RELATION TO THE TREATMENT OF FRACTURES.

THE assistance given to the surgeon by radiography in the diagnosis of fractures and diseases of bone is one of the outstanding features of the progress of science.

It is now an every-day occurrence to take a skiagram of a fracture after the injury and after the surgeon has "set" the fracture, and so to ascertain if the bone is in the position which he wishes it to be. The subsequent formation and absorption of callus can be seen by further examination. The introduction into the tissues of metal plates, bolts and bone grafts, in the treatment of fractures, marked advances in surgical treatment, and the fate of these bodies and their effect on the bone is seen on the X-ray plate. This enables the surgeon to determine whether the fracture has united, and whether the foreign body introduced has had any untoward effect on the bone. A loose plate, the formation of a false joint, and fractures of a bone graft can be diagnosed by means of the Röntgen rays.

Experimental work in the laboratory in the union of fractures dates back to the seventeenth century, but it is comparatively recently that the histological changes in the periosteum and bone in the neighbourhood of a fracture have been studied. Recent workers on the function of periosteum, bone, and the method of union following bone grafting, have been able to study the conditions by radiography as well as by the use of the microscope. The knowledge of the experimental work on animals is of the greatest importance to the surgeon, but the progress of each case of a bone graft must be watched by means of a skiagram. Hence, it is found that the mass of experimental work in frogs, rabbits and dogs is confirmed in man by studying the skiagrams at intervals after bone grafting.

INDICATIONS FOR BONE GRAFTING IN A LONG BONE.

In the treatment of fractures bone grafting can be used in cases of :—

- (a) Non-union.
- (b) Fibrous union.
- (c) A gap between the two fragments.
- (d) False joint at the site of fracture.

Among the alternative methods of treatment for the above conditions are :—

- (a) Metal bolts, plates, and screws.
- (b) A step operation, whereby the bone is shortened and morticed.

(a) These methods of treating the conditions described are less useful than they are in other fractures. This appears to be the case owing to the changes occurring in the ends of the ununited bone, which will be described subsequently.

(b) A step operation has the advantage of not requiring the introduction of a foreign body into the tissues, but the limb will be shortened considerably, as in order to approximate bone, which has osteogenetic power, it will be necessary, invariably, to remove a considerable portion of the bone at the ends of the fragments.

Furthermore, fixation of the fragments together is difficult, when the surgeon has before him the fact that he must spare every centimetre of bone he can, so as to shorten it as little as possible. Hence, after this operation the external splinting is of importance.

Case 1, Fig. 1, shows a humerus which had been fixed by a bolt, such as suggested by Cuthbert Wallace.¹ A false joint resulted, and it was obvious that further treatment to obtain union was necessary. A step operation was performed in 1919, and union resulted in mal-position owing to the difficulty of external splinting in this case. It so happens that the man is able to work on a railway with his short united humerus, but in view of more recent experience with bone grafting, it is probable he would have had a straighter arm, and even with the fragments approximated it would be slightly longer.

The preference for an autogenous bone graft, in the treatment of the four conditions mentioned, is founded on experience in man and experimental work

on animals. The skiagram of every case shows the condition of the bones which is likely to be found, and in order to explain the choice of bone grafting for this type of case, and the *contretemps* that may occur, it is necessary to understand the morbid anatomy of the parts involved.

MORBID ANATOMY.

1. *Skin and Fascia*.—Gaps in bone have been more common during the last eight years owing to the effect of missiles of war. Hence the skin and fascia over the site of injury is often replaced by dense scar tissue. Should sinuses be present the case requires other treatment before grafting is applicable.

2. *Muscle and Tendon*.—These structures are often scarred owing to injury to the limb by missiles. Portions of muscle and scar may be interposed between the fragments of bone.

3. *Periosteum* is found to be normal about an inch from the end of the fractured fragment. The inch from the fracture is thickened and less vascular than normal periosteum.

4. *Bone*.—The bone presents many different features:—

(a) If much sepsis has been present and the fracture is of old standing, rarefaction of the whole bone is often present.

(b) Bone ends are rounded off and the compact tissue is sclerosed—that is, the end of the bone is replaced by “bone scar tissue,” called sclerosed bone.

Osteophytic outgrowths in the form of spikes and nobs—sclerosed bone—often project from the end of a fragment. On the other hand, atrophy of the compact bone may be seen, and the end of the fragment be a shell of bone enclosing soft yellow fatty tissue in the medulla.

(c) A chronic abscess or infection may be present in the bone.

(d) Gross infection is unlikely to be present when the case is presented for bone grafting.

5. The tissues between the bones may consist of:—

Muscle, especially triceps in the arm.

Scarred muscle.

Fibrous tissue.

A joint cavity, containing serous fluid, and at times loose bodies.

PREPARATION OF THE SITE OF OPERATION.

The question of one-stage or two-stage operations is a debatable point among surgeons still, but it seems politic, after considering the morbid anatomy, to adopt a two-stage operation in certain cases. Among the principal indications for a two-stage operation the following present themselves:—

1. Much scarring of skin where incision has to be made. This is dealt with by excision of the scar and either suture or pedicle grafting of skin and subcutaneous tissues from another portion of the body.

2. The presence of metal in the neighbourhood of the intended graft, whether it be a missile or metal previously inserted to obtain union. This is removed.

3. Bone, which radiographically is possibly infected. This is exposed, a culture taken, and the suspicious bone removed with a gouge. Such conditions being present, one or more can be dealt with at the same time as a preliminary operation, and if healing is by first intention a period of two months elapses before grafting.

A pedicle graft is not recommended at the same time as a preliminary operation on the bone, and in any case an interval of six months is allowed between the healing of all sinuses and the preliminary operation or bone graft. That this interval stated as a definite period is unscientific, is recognised, and that Goadby has shown that organisms of virulent type exist longer than that, is pertinent, but experience shows that a six months interval is a safe one in the majority of cases.

Further value of this preliminary operation is seen in the lighting up of unsuspected latent infection.

4. Gross deformity owing to loss of substance of the bone should be corrected before grafting. For instance, radial adduction of the hand occurring after the loss of two or three inches of the radius will necessitate stretching muscles and tendons by splinting or plaster prior to insertion of the graft.

Some cases will require no preliminary operation, as the skin presents little scarring and the bone is found to be suitable for grafting, a condition suspected from study of the skiagram. Case 2, Fig. 1.

BONE GRAFT.

It is well recognised by all who do bone surgery that a technique must be followed which will enable the surgeon to exclude the possibility of any infection being introduced into the wound. After careful preparation of the skin at the site of the operation, the incision is planned so that the graft will not lie subcutaneously. The skin is occluded from the wound by veils, and henceforward only instruments introduced into the wound.

The fragments are exposed, the periosteum raised from the bone for a distance which will correspond to the length of graft required, except when it is the surgeon's intention to use an intramedullary graft. In this case it will not be necessary to raise normal periosteum, but to resect all fibrous tissue between the bones and over-sclerosed osteophytic outgrowths and raise the thickened periosteum from the ends of the bone.

Sclerosed bone is cut away, as this scar tissue does not readily form new bone. Healthy bone is exposed in each fragment so that the medullary cavity is seen. A groove is cut with the motor saw if an inlay graft is to be used.

The length of graft required is measured by a sterilised steel measure, and this wound covered with a towel. A graft of the required size is cut with a motor saw from the tibia, so as to consist of periosteum, compact tissue and

medulla. The inner surface of the tibia is a suitable place to cut a graft from. The graft is removed and leg wound closed.

The graft is taken in forceps and placed in the wound already prepared.

METHOD OF IMPLANTATION.²

1. Intramedullary, both ends ;
2. Intramedullary, one end, and lateral inlay at the other ;
3. Lateral inlay both ends ;

are the methods in common use.

The method of choice depends upon the bone to some extent, and on the method of fixation used by the surgeon.

An intramedullary bone graft is an excellent internal splint, and so seems especially applicable where a single bone exists, *i.e.*, in case of humerus or femur. No other fixation is then necessary.

In the case of the inlay graft the mechanical skill of the operator must be a factor, as if he can cut his graft so that it fits accurately, no fixation, unless it be No. 4 catgut or kangaroo tendon, is necessary.

In forearm bones, an intramedullary graft at one end and a lateral inlay fitting well, is serviceable, as no fixation is necessary, and if the inlay is put on the side of the bone so that the strain will keep it in place, the graft lies quite firm.

Some surgeons prefer fixation with plates or wire, but in the majority of cases it is possible to get good apposition of the fragments without the introduction of these foreign bodies, which, after they have served their purpose, often have to be removed. An additional length of graft often will ensure better fixation.

When a bone is a shell, as described previously, the shell may be split longitudinally, and a graft bound into the medulla by No. 4 catgut or kangaroo tendon round the shell. As would be expected, osteogenesis is often rapid. The object of the operator should be to get good apposition of the graft to the host bone and to get good fixation.

The great importance of good apposition cannot be exaggerated, although it is probable that some bones when bridged by a graft have united when apposition has not been mechanically perfect. Case 3, Figs. 1-3.

The wound is closed in layers after hæmostasis is secured, the graft being covered by as much tissue as possible. External splinting is applied, plaster, unless there appears to be the probability of a hæmatoma owing to the extent of the wound and difficulty in hæmostasis. The plaster is changed after six weeks, and the condition of the bones and graft seen by means of a skiagram. The length of time plaster is necessary is judged in each case by the skiagram. Suppose there is evidence of plenty of new bone formation after five months, as in Case 3, Fig. 4, a bivalve plaster is made and massage and passive movements commenced. Later the bivalve is worn for a portion of the day, when the patient is liable to any injury, such as travelling through the town, and is discarded at home.

RESULTS.

Firm bony union following a bone graft enables the patient to fulfil his ordinary work.

In the series of skiagrams chosen, the intention is to demonstrate the *contretemps* that are liable to occur as well as the success following bone grafting. Failure to obtain union³ after operation by bone graft is due to the following causes:—

1. *Making up of latent infection, and so causing suppuration in the wound.*—The usual effect of this is to cause death of the graft and necrosis of the ends of the bones to which the graft was applied. The graft and a portion of the bone become sequestra. Strange to say, it is a well recognised fact that some grafts fulfil their function in spite of suppuration.⁴ Profuse osteogenesis is caused and the bone unites; all or part of a graft may become a sequestrum and require removal. Case 4, Figs. 1-5, exemplify this.

2. *Poorly nourished covering of the graft owing to deep scar and skin cicatrices.*—These are avoided by preliminary operation.

3. *Defective technique in application of the graft*—

(a) The extent of contact between the graft and the host bone is too small, and fixation of graft is not sufficiently stable. The writer has never found it necessary to use wire or plates to obtain fixation of the graft, and makes every endeavour to avoid using them, as the chances of causing profuse suppuration, should any latent sepsis be present, are considerably increased. Their introduction often necessitates a further operation for removal after they have served their purpose, as rarefaction of bone around the metal is constant at first, and later, although many tighten up and even get partly or completely covered by bone, others work loose, even under aseptic conditions of bone grafting.

(b) Inaccurate apposition is probably the cause of failure in some cases, although Case 3, Figs. 1-3, show far from good apposition, and the result was satisfactory.

(c) Insufficient sclerosed bone removed from the host bone, so that at the site of contact of the graft there is insufficient power of osteogenesis.

4. *Fracture of the graft.*⁵—This may be due to trauma, and occur just as a fracture of any other bone. Hence, such fractures of grafts are most commonly seen subsequent to removal of splints, the graft being too frail to withstand the strain put upon it and insufficient new bone being formed to stabilise it. The common fracture of the graft occurs during the first three months after the operation, and is due to osteoclasts proceeding so rapidly that there is an area of rarefaction across the graft and it falls apart. Case 5.

It appears to be commonest at the point of the graft where the latter joins

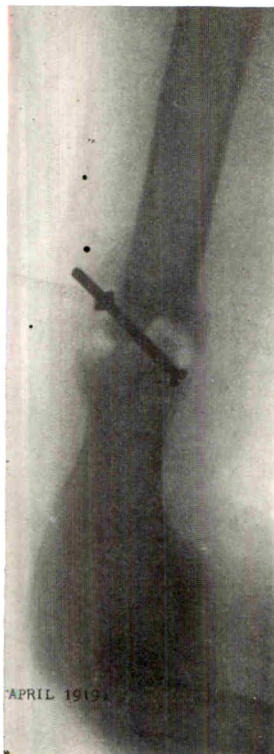


FIG. 1.

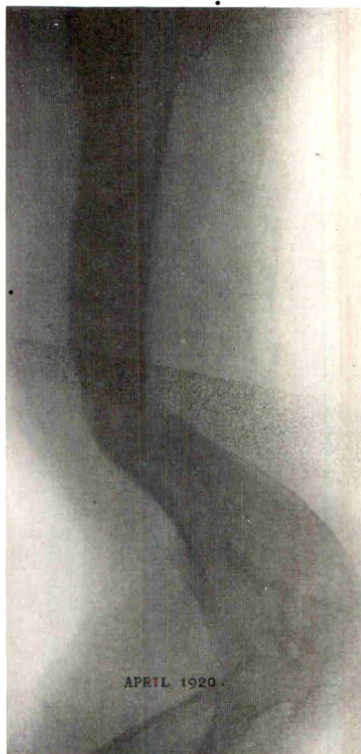


FIG. 2.
CASE 1.

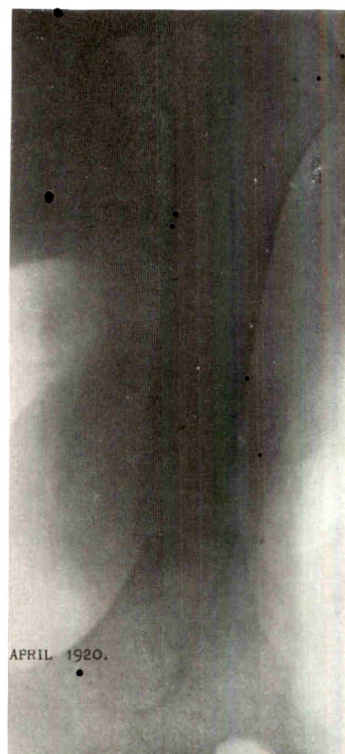
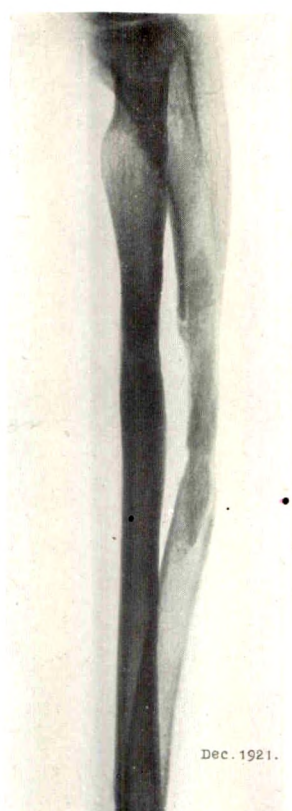
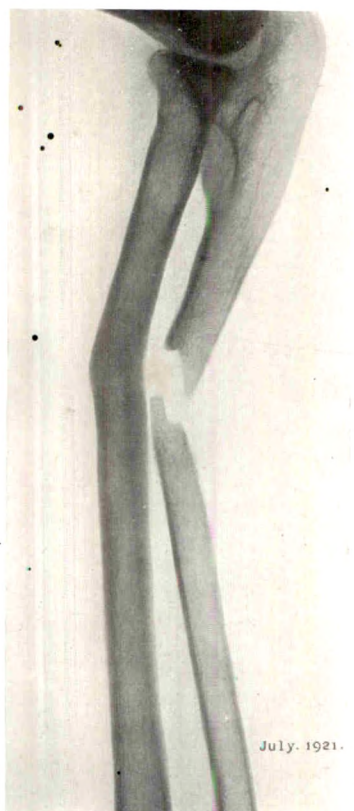
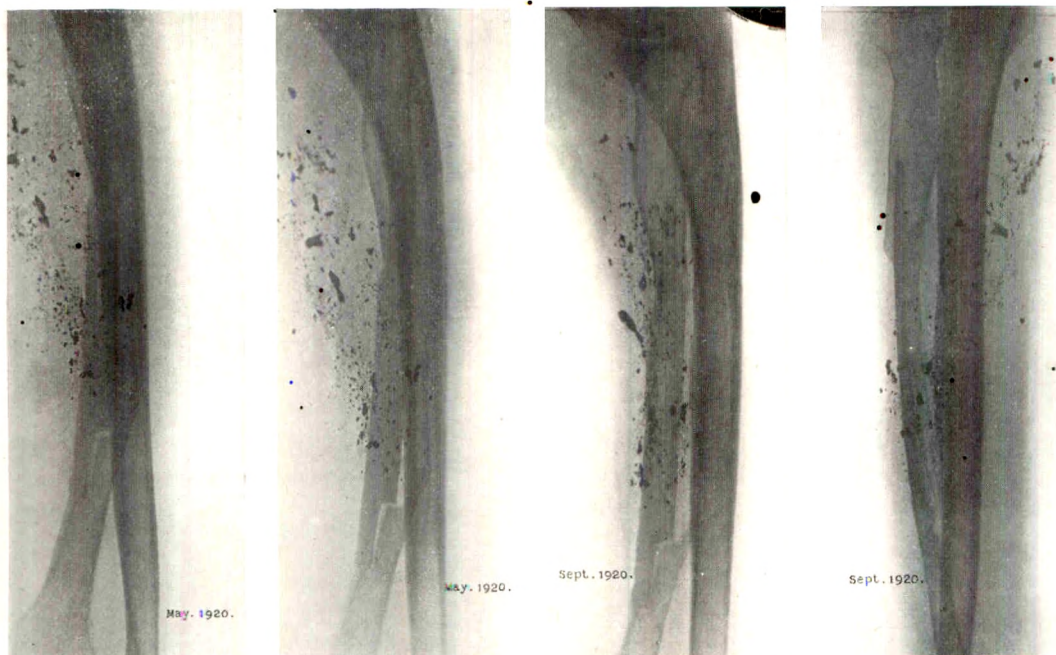


FIG. 3.

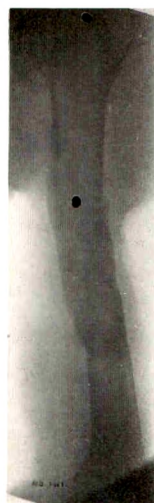
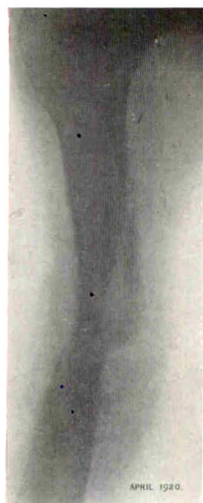
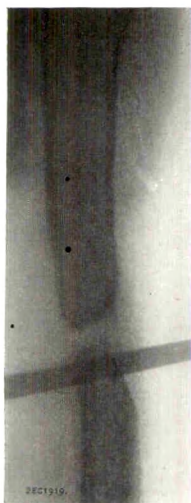




CASE 3.



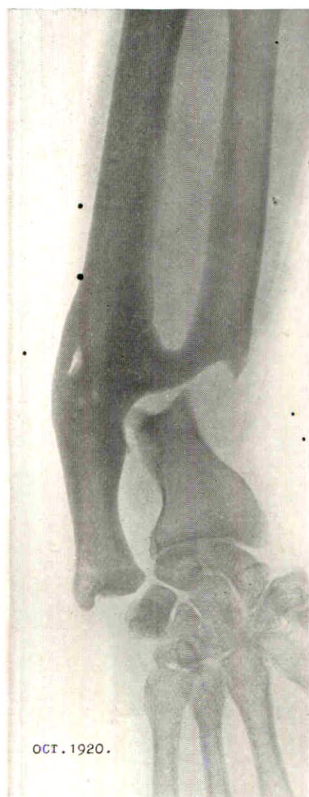
CASE 3.



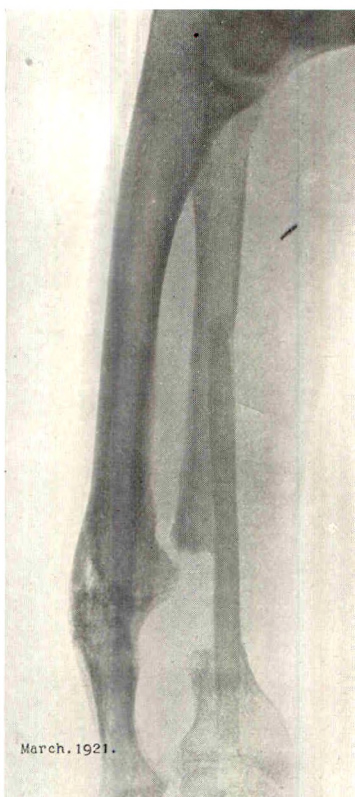
CASE 4.



CASE 5.



OCT. 1920.



March, 1921.

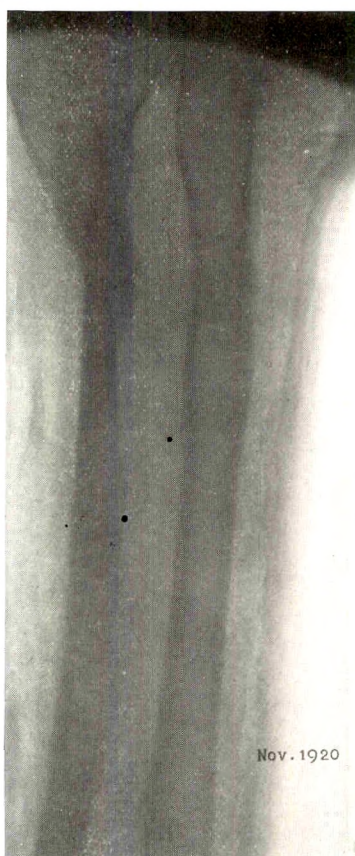


Feb. 1922.

CASE 6.



MAY. 1920.



Nov. 1920

CASE 7.

the proximal fragment of the host bone, and is most frequently seen in the humerus, ulna, and tibia.

Two cases of grafting of the ulna, followed by early fracture, were investigated by further operation. In each case the upper end of the graft had been placed intramedullary into a fragment of the ulna not three inches in length. This fragment of ulna had a great tendency to flexion and abduction, and the graft was very tight, so that when fixed to the lower fragment there was much strain on the graft at its junction with the upper ulna fragment. Doubtless the very tight fit of the intramedullary graft, like a cork in a bottle, prevented a proper blood supply to the graft, and then the tension caused the fracture. When a graft has occurred the limb should be kept splinted, as if the fracture had not occurred, and the subsequent events watched by radiography.

Some fractured grafts showed marked osteogenesis, callus being formed at the site of the fracture,⁶ but in others no effort at union is seen and a false joint is formed.

The value of radiography in watching the progress cannot be exaggerated. In the case that goes straightforward, it is by the skiagram as much as by the apparent strength of the limb that we can judge for what period a splint should be worn. In the complicated case, the untoward occurrence can be exactly diagnosed by study of the skiagram.

Case 6 is an example of cross union between the bones of the forearm with non-union of the radius. The details of the operation are stated with the plate.

Case 7 is that of a case that was grafted twice. The first graft put in, in Scotland, fractured, and the second graft united firmly.

I wish to express my thanks to Mr. H. A. T. Fairbank for permission to use Cases 1 and 4 of cases upon which he operated, and to Dr. Russell Reynolds and Dr. Tindall Atkinson for their help in the interpretation of the skiagrams.

REFERENCES.

1. Cuthbert Wallace, *Lancet*, May 15th, 1915.
2. E. Hey Groves, "On Methods of Treating Fractures," Bristol, 1921.
3. H. Platt, *Lancet*, Feb. 1st, 1919.
4. Ollier, "Traité expérimental et clinique de la régénération des Os," Paris, 1867.
5. C. Max Page and G. Perkins, *Brit. Journal of Surgery*, 1922, IX, 540.
6. Phenister, *Surg. Gynaecol. and Obstetrics*, 1914, XIX, 303.

DESCRIPTION OF PLATES.

CASE 1.—FIGS. 1-3. Case of G. S., wound of arm with false joint in middle of humerus. A bone plate had been put into the arm in 1915 in Germany, but non-union resulted, and this was removed on his return home and a bolt substituted. In August, 1919, there was non-union of the humerus, and Fig. 1 shows a false joint probably present. The bolt was removed, ends of the bone freshened, dovetailed and fixed with kangaroo tendon passed through holes bored in the bone. At least 2½ inches of shortening were expected. Angulation resulted owing to difficulties of external splinting in the case. Firm union resulted in twelve months, with a short arm, movement at the elbow joint being possible within a range of 70° to 150°. He is now a goods porter at Crewe. Patient was a soldier, age 21 when wounded and taken prisoner in 1914. Wound from operation of bolt insertion healed January, 1919. Bone shortened in August, 1919. In view of more recent cases, the insertion of a graft would have made it possible to give the patient a longer humerus and one with less angulation, and the skiagrams are shown as an instance where a better result would be expected by use of a graft.

CASE 2.—FIGS. 1-3. Case of G. S., wound of forearm with united fracture of radius and fibrous union of ulna. A preliminary excision of scar was performed with removal of some of the bone. Bone graft was done and only a short graft put in, although a considerable gap existed after the sclerosed bone had been removed. Intramedullary upper end and a lateral inlay fixed with kangaroo tendon to the lower end. Firm union resulted. Patient was a soldier, age 24 when wounded in 1916. Wound healed in 1918. Ulnar nerve sutured in September, 1920, and bone graft in September, 1921.

CASE 3.—FIGS. 1-7. Case of G. S., wound of forearm with loss of two inches of radius. Bone graft operation in April, 1920, intramedullary in upper fragment and lateral inlay to lower fragment. In spite of poor contact of the lower end of the graft, union occurred, and the skiagram taken two years after the graft shows that the bone is reconstituted, and possibly a medullary canal has been formed in the graft. Many small pieces of metal are seen in the soft tissues. Patient was a soldier, age 22 when wounded in 1916. Wound healed in 1917. Median nerve sutured in January, 1920, and bone graft in April, 1920. The stages in the repair of the bone are shown in the series of skiagrams.

CASE 4.—FIGS. 1-5. Case of G. S., wound of arm with fracture and non-union of humerus. A preliminary pedicle graft was performed. Bone graft, intramedullary, was done. Profuse suppuration followed, and this and the necrotic graft are shown in the second and third skiagrams of the series. When the graft was removed nine months after it had been put in, the humerus was united and the sinuses quickly healed, leaving the patient with a humerus of great strength. The wound has remained healed over eighteen months. Patient was a soldier, age 29 when wounded in August, 1918. Wound healed in February, 1919. Pedicle graft was done in May, 1919, and bone graft in January, 1920. The sequestrum of the graft was removed in September, 1920. This is shown as an instance of union of bone occurring in spite of suppuration.

CASE 5.—Case of G. S., wound of forearm with fracture and non-union of ulna. Skiagram shows a fracture of the graft at the junction of the graft with the upper fragment of the ulna. Graft was intramedullary in the upper fragment, and laterally implanted into the lower fragment. This fracture was in no way due to trauma, and occurred at an unknown time during the five months subsequent to the bone graft.

CASE 6.—FIGS. 1-3. Case of G. S., wound of forearm with fracture of radius and ulna, resulting in union of the ulna, non-union of the radius, but synostosis between the upper radial fragment and the ulna. The synostosis was divided and muscle pulled between the bones and sutured there. A 5-inch graft was applied laterally to the upper fragment and intramedullary to the lower end of the radius. The gap was just over an inch. Union of the radius occurred and the synostosis did not reform. There is a subluxation of the inferior radio-ulnar joint. Patient was a soldier, age 25 when wounded in 1917. Wound healed in 1919, and the bone graft operation was performed in November, 1920.

CASE 7.—FIGS. 1 and 2. Case of G. S., wound of forearm with false joint in upper part of ulna. The skiagram taken in May, 1920, shows false joint and considerable new bone formation around this. The upper three inches of the lower fragment consist of bone formed from a graft that had been put in at a previous operation and had fractured, and the false joint formed. The bone was freshened and grafted by an intramedullary graft to the upper fragment and an inlay to the lower. The patient was boxing, in spite of the surgeon's orders before he left hospital. Patient was wounded in March, 1918. It healed quickly, and he informed me the first graft was done in December, 1918. The graft shown in the skiagram was performed in June, 1920.

A METHOD FOR THE OPAQUE MEAL EXAMINATION OF THE STOMACH.

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INTRODUCTION.

THE value of the opaque meal examination in the diagnosis of pathological conditions pertaining to the stomach and small intestine is now fully recognised. Each year sees an increase in accuracy, and I believe that the time will come when it will be possible to detect practically every gastric lesion of an organic nature, both great and small, by this method of investigation.

Its application, however, requires great care and attention. It is beset with pitfalls. For instance, deviations from the normal, as we know it, are

very apt to be mistaken for pathological conditions, and such errors can be avoided only by practical experience, by extremely careful observation, and recording of facts.

The radiologist must realise his responsibilities. His opinion should always be based on sound evidence. His report on a case may turn the scale and apparently justify an operation. If, therefore, his evidence is weak or incomplete, he should have no hesitation in saying so.

It is unnecessary for me to emphasise the diagnostic value of the opaque meal examination of the stomach in a meeting like this. We must not, however, lose sight of the fact that it is still but in its infancy and that our methods are by no means standardised. We must, therefore, be constantly seeking to improve its diagnostic value, and must not be content to jog along in a groove.

The grosser gastric lesions can be detected by almost any method—it is the minor lesions that really test its value.

CURRENT METHODS.

Various methods have been advocated from time to time by workers in different parts of the world. Some of these are ingenious but of little practical value in diagnosis. Others, which have proved their worth, are still in vogue.

It is interesting to note how countries favour one method rather than another. For instance, in America, radioscopy was little used until recently, diagnosis being dependent upon the evidence obtained from a number of plates. Many dozen radiographs may be taken during the course of the examination. In England this would be considered an impracticable and expensive procedure for a busy hospital, and, in my opinion, its diagnostic value is not sufficient to justify the expense which it entails.

On the Continent a combined plate and screen examination is the most popular.

In this country, although screening is considered of value, the evidence obtained from radiographs is thought to be of still greater importance. The history of the case, together with the unreliable gastric complex—that is to say, the behaviour or type of the peristalsis, or rate of emptying of the stomach—is given, I think, too great a diagnostic value.

I have, like many others, thoroughly tested these various methods over a number of years. While practically all of them will indicate the presence of such gross lesions as a large penetrating ulcer, with biloculation or a new growth of the stomach, they have proved to be of uncertain value in the diagnosis of a very small gastric or duodenal ulcer. For several years I have been working on a definite line of technique, and I consider that it has stood the test better than any other, and if I now think it worthy of description, it is because for over three years it has consistently given over 94 per cent. of correct diagnoses, year in and year out. Those of my colleagues who are responsible for hospital work will appreciate what this means. Some surgeons are still severe in their criticism of the examination, but what other branch of medicine can show so high a diagnostic value?

SYSTEMATIC RADIOSCOPIC PALPATION.

Systematic radioscopic palpation, which must not be confused with the stomach-prodding or palpation used by many workers, consists of a minute and systematic examination of the entire wall of the stomach and duodenum. The barium cream, which is given as the opaque meal, is, as it were, smeared over the mucous membrane of the stomach, so that the folds are easily visualised and any distortion or defect can be detected. By this method both the anterior and posterior surfaces of the stomach can be examined minutely. This is of considerable importance, for with most other methods ulcers in these positions are frequently missed, owing to the fact that they are not, so to speak, on the sky-line—that is, they are not situated on the lesser or greater curvature of the stomach. Fortunately for radiologists, the majority of ulcers occur in the latter positions. This systematic palpation is carried out inch by inch, starting at the cardiac and ending at the duodenal end.

Although this method is quite simple and does not involve the use of expensive apparatus or of plates, it places a somewhat heavy strain on the radiologist in a busy hospital. Proficiency, however, lessens this difficulty.

In radioscopic palpation the diagnosis depends solely upon direct evidence of the lesion. That is to say, a definite diagnosis can be given only when the lesion has been visualised on the fluorescent screen. The radiologist has thus an advantage over the physician and surgeon, who merely suspect the presence of a lesion, and whose diagnosis is based almost entirely on indirect evidence.

The method I am describing to-night has been of gradual growth and has really been forced upon me on account of the conditions under which one has had to work at the London Hospital.

Owing to the ever-increasing number of opaque meal examinations required, everything which did not prove to be of diagnostic value had to be discarded.

The method must be rapid and accurate, and the expense reduced to a minimum, but without sacrificing accuracy.

The diagnostic value of radiographs as against the screen examination was also forced on me some years ago by a case where the lesion was easily seen on the screen, but, owing to its position, severely taxed one's ingenuity to demonstrate on a radiograph. My reliance on radiographs in gastric cases since then has waned.

As a satisfactory radioscopic examination requires attention to many small technical details, I propose to describe these rather more fully than might be considered necessary.

CLINICAL HISTORY.

Generally speaking, it is unnecessary for the radiologist to know the clinical history of a gastric case. I know that on this point I am at variance with most of my colleagues, but I think that confidence in one's method of diagnosis is proved if the diagnosis can be given independently.

I think that any careful physician or surgeon will admit that the clinical

history of a case is often unreliable and misleading—otherwise, why do they ask the radiologist's help—so that, on the whole, it is better for the radiologist to undertake his investigations with an entirely open mind, unhampered by any preconceived opinions and suppositions.

I was interested to see the following statement, supporting this contention, in a recent paper by Carman, of the Mayo Clinic: "However helpful the clinical facts may have been in the developmental stage of gastric radiology, and however necessary this still may be for the interpretation of other radiological findings, their employment at this time by the radiologist in diagnosis of duodenal or gastric ulcers is unnecessary, and would increase, rather than diminish, his mistakes."—*Journal of Radiology*, Vol. III, No. 12, December 22nd, 1922.

DIAGNOSTIC VALUE OF RADIOGRAPHS.

I know that many of my fellow radiologists will again be at variance with me on the question of the value of radiographs in the diagnosis of gastric lesions. I have been forced by practical experience to credit radiographs with secondary importance, for I found that in many difficult cases, such as a small ulcer on the anterior or posterior surface of the stomach, or high up towards the cardiac end, it was extremely difficult to demonstrate the condition on a radiograph, although the diagnosis was already definite from the screen examination.

I do not mean to say that I have discarded radiographs entirely in gastric work; they may be of value in some cases, but many a small ulcer will be missed if too much reliance is placed upon them. Of course, they will easily demonstrate grosser lesions, but we are chiefly concerned in finding a method of detecting the smaller ulcers which are easily overlooked. Radiographs, however, are useful for recording unusual conditions and for demonstration of the lesion to the surgeon.

I even go so far as to state that any lesion demonstrated on a radiograph would easily be diagnosed by radioscopic palpation, but that the reverse does not hold good—namely, a lesion demonstrated by palpation would not necessarily have been diagnosed from the radiograph.

A METHOD FOR THE KEEPING OF STATISTICS.

With regard to statistics, in order to estimate the diagnostic value of any method, operative findings must be compared systematically with the radiological findings. To many radiologists attendance at abdominal operations is not always possible. At the London Hospital this difficulty is overcome by the use of special forms affixed to the report sheets; these are filled up at the time of operation by the surgeon, giving particulars of the condition found. The forms are returned at once to the department and compared with the radiological findings. The accuracy of the radiological diagnosis can thus be checked week by week and year by year.

RAPIDITY OF METHOD.

The two chief advantages of radioscopic palpation are that it can, after a time, be carried out with rapidity, and that it is extremely accurate in the detection of small lesions.

In a busy hospital rapidity in gastric work is of the greatest importance, but, at the same time, accuracy must not be sacrificed to speed. In a straightforward case, such as, for instance, that of a duodenal ulcer, a diagnosis can be given within five minutes—little more than the time required for the examination of a normal case. I have been able to examine as many as twelve gastric cases in the course of an hour. The radiologist should have good sight, strong wrists and forearms. Suitable arrangement of the screen and patient, so that palpation can be comfortably and efficiently carried out, is also necessary.

The installation must be one which will give a steady screen effect, and the fluorescent screen should be the best obtainable.

Concentration on the part of the operator is important, and protection, both to the operator and patient, must not be neglected.

Accuracy of Method.—The accuracy of a method which yields a percentage of 94 per cent. of correct findings, under hospital conditions, cannot be doubted, these statistics being based on cases which have passed through the department within the last two years, in which the diagnosis has been confirmed either by operative findings or by post-mortem examination. They do not include cases which have yielded to treatment without operation, or which have been considered by the surgeon as inoperable. The actual figures are given in the *Lancet* of November 18th, 1922.

It must be remembered that errors in diagnosis, if traced to their source, are of extreme value. Every mistake, therefore, should be thoroughly investigated. A paper on incorrect diagnoses traced to their source would be extremely interesting reading. It is a mistake to slur over one's failures.

TECHNIQUE.

Preparation of the Patient.—A vegetable purgative, preferably castor oil, is administered thirty-six or forty-eight hours before the examination, the patient being then put on a light diet, but not starved. The last meal, which should consist of fluids, such as soup or bread and milk, should not be taken less than an hour before the examination.

The object of this preparation is (1) to have the intestinal tract as empty as possible to facilitate the examination, while at the same time avoiding artificial conditions; that is to say, the effect of the aperient must have passed off. (2) The patient should not feel unusually hungry, as this condition has a definite reflex effect on the behaviour of the stomach.

The patient should wear a special garment which can be easily slipped on or off, made of some washable material, free of opaque bodies, such as buttons, hooks and eyes, etc.

COMPOSITION OF THE MEAL.

Barium sulphate is the salt now used by practically all radiologists. It is admirably suited to the purpose, but difficult to administer in a palatable form. Much time is wasted in trying to persuade patients, who are already suffering from some form of gastric disturbance, to swallow distasteful and nauseating mixtures.

After several attempts, I eventually found a very palatable mixture, which I have now used for some years. It has saved much time and inconvenience both to myself and patients.

This barium cream, which has been commercially christened *Ramul*, is made in three thicknesses: No. 1, thick flavoured, for œsophageal cases; No. 2, medium thickness flavoured, for gastric cases; No. 3, thin and unflavoured, for opaque enemata. These, being sterilised, keep for weeks, and can therefore be kept in stock. The barium itself is well held in suspension. The prescription is as follows:—

No. 1.—*Thick Flavoured.*

Barium Sulphate	...	...	...	10 ozs.
Saccharin	...	...	...	2 grains.
Vanillin	...	...	...	5 grains.
Gum Tragacanth	...	...	...	100 grains.
Distilled Water	...	...	to	20 ozs.

No 2.—*Thin Flavoured.*

Barium Sulphate	...	...	...	10 ozs.
Saccharin	...	...	...	2 grains.
Vanillin	...	...	...	5 grains.
Gum Tragacanth	...	...	...	60 grains.
Distilled Water	...	...	to	20 ozs.

No. 3.—*Thin Unflavoured.*

Barium Sulphate	...	...	...	10 ozs.
Gum Tragacanth	...	...	...	60 grains.
Distilled Water	...	...	to	20 ozs.

The gum tragacanth and the barium sulphate should be mixed as powder, and the water added gradually. The whole is sterilised. It is better made up by a chemist, and a stock bottle can be kept for emergency. Being sterilised, it can be used for other purposes, such as injecting into the sinuses or empyemas, using whichever thickness is most suitable for the case. This barium cream throws a very dense and homogeneous shadow, creeping readily into nooks and crevices, such as ulcer craters, appendices, etc.

Quantity.—There is no hard and fast rule as to the amount of the meal to be given in a gastric case, any more than in an œsophageal case. It is dependent on what method is employed and on what the radiologist wishes to demonstrate.

Radioscopic palpation cannot be efficiently carried out if the stomach is too full of the meal, for this condition makes it difficult to displace the contents so that each section of the mucous membrane may be examined in detail, and a

small ulcer, when situated on the anterior or posterior surface of the stomach wall, may easily be masked by the dense shadow of the full stomach.

For this reason only a small quantity (three to four ounces) is given at first; this can be displaced upwards by manipulation and smeared over the interior of the stomach without difficulty.

A further six ounces or more may be administered later as required. This is especially necessary if the whole intestinal tract is to be examined.

NUMBER OF EXAMINATIONS.

Owing to the large increase, in recent years, in the number of cases requiring the opaque meal examination, I have found it necessary to discard everything that has not proved to be of some diagnostic value. One of the first things which I investigated was whether the rate of emptying of the stomach gave any reliable information as to the state of the organ itself. I know that most radiologists make repeated examinations to determine the rate of the emptying of the stomach, but as I could recall no case in which this had helped me to a diagnosis I began to doubt its value.

I therefore carried out a few simple tests with students and others, and my conclusions were as follows: In a normal stomach the rate of emptying is influenced to a large extent by (1) the mental condition of the patient during the examination—fear and apprehension, for instance, were found to retard the emptying rate by several hours. (2) An unpalatable meal and indifference to food also retarded the rate. (3) Hunger and a relish for the meal increased the rate of emptying by some hours. (4) Food taken before the stomach is empty of the opaque meal led to an apparent delay. It was possible to obtain a difference of four hours in the emptying rate of the stomach in the same patient by starving or over-feeding him a day or two before the examination.

As this showed that the rate of emptying was influenced by so many unknown factors, I decided that frequent examinations had little, if any diagnostic value, and so discarded them.

If there is some mechanical narrowing, say of the pylorus or duodenum, which is sufficient to cause delay, this should be easily detected at the first examination. One learns nothing more by noting, hour by hour, how much of the meal has passed into the small intestine. In all normal stomachs the meal should be seen passing through the duodenum at the first examination. Carman states that free opening of the pylorus is retarded by coarse particles of food.

THE DOUBLE MEAL.

This method is advocated by some radiologists when the stomach and colon are being investigated. The first meal is given a certain number of hours before the examination. By the time this takes place the colon is full and the stomach empty. After the colon has been investigated the second meal is administered and the stomach examined.

I have discarded this method, as I have found that although, in theory, it should save time, in actual practice it may lead to serious errors in diagnosis.

For instance, the evidence of a gastric ulcer may depend on a very small fleck lying close to the stomach shadow. If an opaque meal, or even bismuth mixture, has to be given to the patient some hours previously, it is quite possible for a small quantity of this to be seen lying apparently in the stomach area, resembling an ulcer crater, although actually it is in the small or even in the large intestine.

In any case, if this method is used, it is necessary to be extremely cautious in diagnosing the smaller gastric or duodenal lesions.

IMPORTANCE OF CONCENTRATION.

The radiosopic examination of the intestinal tract necessitates a considerable amount of concentration on the part of the operator. When a number of cases have to be examined all outside disturbances should be avoided.

The whole departmental organisation must run smoothly. There should be no unnecessary delay between the examination of patients. By the time the report on one patient has been written the next should be in position. All outside disturbances, such as telephone calls, messages, and so forth, should be attended to by a deputy. The whole examination should be carried out systematically, and as far as possible in silence. The shouting of instructions to deaf or stupid patients can be avoided by having full control of their movements. Comfort assists concentration.

The design of the upright diascope for gastric cases should enable one (1) to sit comfortably in a chair, (2) to use both hands for abdominal palpation without being cramped, (3) to get at the patient, so that by gripping the hips he can be moved in any direction required without a word having to be spoken.

If these points be observed the value of the operator's diagnosis will be enhanced, much mental fatigue will be avoided, and tempers will not be ruffled during heavy hospital work.

SYSTEMATIC EXAMINATION.

As it is not possible for the operator to protect himself completely from the rays while screening, it is essential that all fluoroscopic work be carried out expeditiously. This can only be done, without loss of accuracy, by systematic examination.

Take, for example, the examination of the thorax. Some definite order or routine should always be followed. Commence by examining the diaphragm, then the heart and aorta, apices of the lungs, hilum and lungs themselves, and so on. Once a section has been passed as normal there is no necessity to return to it.

The same systematic method should be employed in all fluoroscopic work. Otherwise time is wasted and the danger to the operator is increased. However obvious the lesion this routine examination should be persisted in. The presence of a chronic gastric ulcer, for instance, does not exclude the possibility of a duodenal ulcer.

APPARATUS.

In all radiological work the apparatus should be as simple as possible. This is still more important when radioscopic palpation is employed. Elaborate mechanism, however ingenious, should be eliminated, and anything that may tend to distract the attention from the work in hand avoided.

In other words, the apparatus should work as smoothly as the organisation of the department.

For the guidance of others the chief features of an upright diascope may be mentioned: (1) The operator must be able to sit comfortably in a chair, and the apparatus must be so arranged that he is not cramped when palpating the patient's abdomen. (2) If the latter point be observed the operator has full control of the patient's movements. The hips can be gripped and the patient moved in any direction. There is then no necessity for shouting instructions. (3) The best fluorescent screen obtainable should be used for gastric work. It should be small; it need not, in fact, be larger than 10 in. by 8 in. Palpation is easier under these conditions, and unnecessary fluorescence around the illuminated area avoided. (4) The patient should have a firm support to lean against, as full palpation cannot otherwise be used. For this purpose I have a metal cylinder, about 8 in. long, fixed to the face of the diaphragm. (5) There must be sufficient space between the back of the screen and the front of the patient for the hands to palpate. (6) There should be an arrangement for the placing of a cassette in position if a radiograph is required. I have achieved this by means of a loaded cassette always in position to the right and left of the screen—protected, of course, from the rays—ready to be slipped behind the screen one after another at any moment.

PROTECTION.

Protection may be considered as part of the apparatus. Thick lead around the tube is by far the safest protection. The chief trouble here, however, is current leakage, but this can be overcome. The lead face holding the diaphragm should be extra thick, and the diaphragm shutters made up of iron and lead. Two sheets of the best tested (N.P.L.) lead glass should be placed over the screen. Under no conditions should it be possible for the rays to be projected off this area.

A filter of aluminium over the diaphragm opening is sufficient to protect the patient. For radioscopic palpation I use specially made protective gloves. They have the advantage of being very light and supple; the protective material is placed on the front and back, and they are lined with soft fabric.

When doing any screen work, however elaborate and perfect one's particular devices may otherwise be, the following protective rules should always be observed: (1) The distance between the tube and screen should never be less than 30 in. (2) Use the minimum amount of current, increasing it for a few seconds as required. (3) The examination should be carried out as expeditiously as possible.

Finally, before a new apparatus is used, protection under all working conditions should be thoroughly tested with a fluorescent screen or other means, from the floor upwards. Efficient earthing must, of course, be seen to.

Under these conditions the method here described is perfectly safe—in fact, the actual screening time is less than that taken by most radiologists over the ordinary method of examination.

PALPATION.

It is important that all manipulation be gentle. The actual palpation should be done as far as possible with the flat of the fingers, *not with the tips*, otherwise a reflex contraction of abdominal muscles will take place, rendering the examination more difficult. Incidentally, rough handling may set up not only spasms of any part of the stomach, but may also cause closure of the pylorus—time being thus wasted waiting for the duodenal cap to fill.

Palpation is an important factor in this method. Some practice is necessary before the knack is acquired, and on it depends, to a great extent, the success of the method. It is necessary that the hands be trained to work in conjunction with each other, as each section of the stomach is examined in detail.

POSITION OF PATIENT.

Unless the diascope is designed for radiosopic palpation on the lines mentioned above, the patient will have to be examined both in the upright and horizontal position, the latter being used chiefly to visualise the pylorus and duodenum.

With the properly arranged diascope, however, I find that a much better view of the pylorus and duodenum is obtained with the patient standing. The meal is more easily manipulated into the pyloric end of the stomach, and the low position of the pylorus and duodenum when the patient is erect simplifies palpation.

If, however, the stomach is much dilated, the contents are difficult to control by palpation, and the right horizontal position has to be resorted to before the pyloric end can be satisfactorily filled.

The mechanism for moving the tube under the couch should be such that both hands are free for palpation. For many years I have used a foot stirrup for moving the tube box. To obtain a good view of the pylorus and duodenum the patient should be lying on his right side. The degree of tilt, however, varies with different patients, and in some cases the best view is obtained with the patient flat on his face. I have devised a small cylinder localiser which is of considerable value in detecting small ulcers, whether of the stomach or duodenum.

Let us now follow the examination in detail through its various stages.

The patient, wearing the special garment already mentioned, is standing up in the diascope with his back to the tube, holding the handles conveniently placed on either side to give him support. The barium cream, in a suitable container, is on a small shelf close to his left hand. He is instructed before-

hand that he will be told when to drink the contents. It is more satisfactory if the patient holds the cup in his left hand, as the first part of the examination necessitates his turning to the left; if his right hand is used, this is liable to be knocked by the screen, and most of the cream may be deposited on one's knees, or, with luck, on the floor.

The operator, comfortably seated in front of the screen, grasps the patient's hips, and the examination is commenced with a rapid but systematic survey of the thorax and abdomen. The patient is given a half turn to his left by means of the hips, bringing him into the oblique position, thus opening up the posterior mediastinum.

He is now told to drink, and the meal is carefully followed in its passage from the mouth to the stomach, as the œsophagus or thorax may be the site of a suspected gastric lesion. The varied manner in which the meal may pass down the œsophagus through the cardiac opening into the stomach cannot be described here.

A few seconds will allow the meal to settle and fill the most dependent part of the stomach. Palpation should not be commenced until this has taken place. The type of stomach, position, etc., is quickly noted.

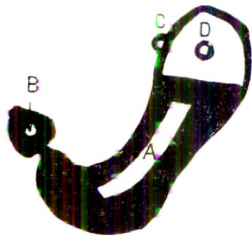


Diagram illustrating areas where ulcers are difficult to detect. A and B on account of being masked by meal; C and D being above the meal.

Without manipulation, the cardiac end of the stomach cannot be distended to the same extent as the lower segment, no matter what quantity of the meal is given. This is the reason, I think, why so many small ulcers high up on the lesser curvature are missed. To overcome this disadvantage, with the patient still in the oblique position, firm pressure is exerted on the lowest part of the stomach with the flat of the left hand—the left side of the patient's back pressing firmly on the compressor cylinder fixed on the front of the diaphragm.

The meal will now be seen to be displaced upwards until the upper segment of the stomach becomes fully distended, and any defect in outline can easily be noted.

There may, however, be a small ulcer lurking on the anterior or posterior surface of this section, in which case it would be masked by the meal shadow. To overcome this the pressure of the left hand is relaxed slightly, and the right hand is brought into play by working in conjunction with the left; the meal can thus be displaced from any part of the stomach wall at will.

The process is not easy to describe, but if one could glance inside the stomach while it is going on, the impression would be that of whitewashing the gastric rugæ. An ulcer crater in their midst would be noted to hold the whitewash more easily than the surrounding folds of mucous membrane, a fleck or dark spot in the midst of distorted rugæ being the result, and if persistent would be typical of an ulcer.

If, however, small ulcers on the anterior or posterior surface of the stomach

are not to be missed, every inch of the stomach wall must be examined in detail. This cannot be done if the organ is too full, as it is difficult, if not impossible, to displace the contents sufficiently. For this reason it is better, as already mentioned, to start with a small quantity of the cream (3 ozs.), giving more, if required, later.

Both hands work down together from the cardiac end, filling and emptying each segment in turn. As the pyloric end is approached the patient is gradually brought round from the left oblique position until square to the operator. This manœuvre opens up the pyloric end, so to speak, and in most cases a slight turn to the patient's right gives the best view of the pylorus and duodenum. There is, however, no orthodox position; the patient should be moved in whatever direction gives the best view of the area under examination.

The pylorus is now reached, and the filling of the duodenal cap carefully observed. This happens fairly rapidly, provided palpation has not been too energetic, in which case spasm of the pylorus is likely to cause a short delay. Light massage will dissipate spasm in a very short time.

The duodenal cap should be examined in the same systematic way. This is simple if it stands away from the shadow of the pyloric end, but in some cases it gets tucked away behind, and considerable ingenuity is required to find a position that will give a clear view.

Great care is necessary in the examination of the cap, as small ulcers are easily overlooked, the defect in shadow being in some cases extremely small.

The duodenum completes the examination.

As previously mentioned, the rate of emptying is of no diagnostic value. Consequently, frequent examinations are unnecessary, unless, of course, confirmation of some abnormality is required.

Occasionally the meal passes rapidly out of the stomach—this will necessitate pressure over the pylorus while the cardiac end and fundus are being examined, releasing the pressure as the pylorus is approached. Once the meal is in the small intestine the stomach examination should cease.

The method I have attempted to describe to-night requires patience and practice before its full diagnostic value is attained. The knack does not take long to acquire, and soon becomes a simple, safe and accurate operation.

Radioscopy in gastric work has not been developed to anything like the extent of radiography. This should be rectified, as I feel sure its value will eventually prove to be even greater than that of radiographs. It is interesting to note how America is now finding this to be a fact—the serial method so in vogue some years ago being gradually superseded.

Perfection is admittedly unobtainable, but we should nevertheless strive to reach it. Radiologists need not be ashamed of their errors in diagnosis as long as they endeavour to find out their cause. At the same time, as Carman says, they should not criticise themselves too charitably.

THE PATHOLOGICAL CHANGES PRODUCED IN THOSE RENDERED UNCONSCIOUS BY ELECTRICAL SHOCK AND THE TREATMENT OF SUCH CASES.

Papers read before the Section of Electrotherapeutics of the Royal Society of Medicine, March 17th, 1922.)

Concluding Papers and Summary by the President of the Section. The Introduction and Papers by other Speakers were published in the ARCHIVES of June, 1922.

Communication by Sir BERNARD SPILSBURY, M.A., B.M., B.Ch. (Oxon), Lecturer in Morbid Anatomy and Histology, St. Bartholomew's Hospital.

DR. SPILSBURY said that he had made about a dozen post-mortem examinations in cases of death from electric shock. In almost all cases it was possible to determine the point of entrance and exit of the current by means of injuries and burns inflicted. Hæmorrhages beneath or in the skin were very constantly found. In the majority there was hæmorrhage into the muscles, and in one case a muscle was partially ruptured from violence of contraction. He had never found injuries to bone or periosteum. Usually there were absent any indications that the current had passed through the deeper structures of the body. He thought that in many cases the discharge might go through the skin mainly and death be the result of stimulation of sensory nerves. There were many parts of the body at which sudden stimulation of the sensory nerves might produce instant death, such as the nasal and laryngeal membranes. A slight blow on the upper part of the abdomen had been followed by death, and there were a number of cases in which stimulation of sensory nerves in the female genital tract had been fatal. Instant death following sudden and unexpected immersion in cold water compared well with that due to electric shock.

The most reasonable explanation of deaths occurring from electric shock was that they were due to a sensory stimulation causing paralysis of the respiratory centre. This justified the use of artificial respiration. Certainly there must be some cases—and there might be many—in which death was only apparent, and in which real death only supervened from the lack of some means of carrying on the essential function of the body.

Communication by S. JELLINEK, Professor of University of Vienna, Corresponding Member of the Royal Society of Medicine.

From whatever point of view the question is approached, the very general opinion seems to be that the problem of death by electricity is a complicated one, and not nearly so simple as when it follows the more ordinary accidents of life, such as poisoning, suffocation, drowning, etc.

From the point of view of time four types of death can be recognised; ignoring minor variations these are:—

1. Instant death (*décès instantané*).
2. Slow death (*décès lente*).
3. Interrupted death (*décès interrompu*).
4. Retarded death (*décès retardé*).

From the point of view of mechanism, or succession of disturbances that follow on the electric shock, four types can again be recognised, among many minor variations :—

1. Death by shock.
2. Death by excessive irritation or paralysis of nervous system.
3. Death by paralysis of the heart.
4. Death by paralysis of respiratory system.

The results of post-mortem examinations agree with the above types, and show that functional disturbances play the most important rôle ; the sections are generally negative ; œdema of the brain and lungs is only a sign of protracted dying. The marks of the electric current we find on the skin of victims are but local injuries. It is true that the microscope shows degenerative changes in the brain, spinal cord, sympathetic nervous system, heart muscle, and other internal organs, but they are not sufficient in themselves to constitute a danger to life and to explain the death. The exceptions being naturally in certain special structures such as the nucleus of the vagus, heart ganglia, etc.

Our experience agrees with these statements ; many victims, rendered unconscious and apparently dead for the longest time, make a complete recovery, showing that the lesions are not so severe as to make recovery impossible. It is noteworthy that in many of these cases the recovery is so complete as to leave no recognisable traces of the accident.

These statements are made as the result of personal observations in not merely hundreds, but thousands of electric accidents ; this extensive experience has not furnished a solution of the problem we are considering, but it has taught me the very important fact that in the great majority of cases death is only apparent at first, and that attempts to revive the patient are likely to be successful more often than not ; artificial respiration should be resorted to at once, as it is of the greatest importance, not only for the lungs but also for the heart and its circulation. I am at present engaged on researches relating to this last point.

This, in my opinion the only way to revive the apparently dead, is disputed in a paper by a medical man in Berlin. He does not offer us a better method of resuscitation, but gives us a “catch-word” instead—ventriculo-fibrillation (*tremulations fibrillaires de ventricules*). As this condition is almost necessarily irreparable, every hope and possibility of revival is naturally excluded. Although this medical man has never seen a human case of ventriculo-fibrillation, nor even a single case of electrical accident, he ignores the experience of others and declares that death by electricity is always due to ventriculo-fibrillation.

Like many another catch-word, this one has not only confused the minds of many responsible people, but it has also been the last cause of death for many victims of electrical shock.

By E. P. CUMBERBATCH, M.A., B.M., B.Ch. Oxon., M.R.C.P. (*Medical Officer in Charge of the Electrical Department of St. Bartholomew's Hospital; President of the Section of Electrotherapeutics of the Royal Society of Medicine*).

It seems that the largest experience in the investigation and treatment of cases rendered unconscious by electric shock is that of Prof. Jellinek, of Vienna. When he gave his address to the present section before the late war, he established in a most convincing manner that death in such cases was due to cessation of respiration, and that the treatment was the application of artificial respiration immediately after the accident, to all cases. His experience since the address has served to confirm still more strongly his own conclusions which he had already reached. The teaching that death is due to fibrillation of the ventricles appears to be based more on theoretical grounds, and on experiments on animals, than on practical experience of the accidents in the human subject. Though we are unable to prove definitely that death may not be due to ventricular fibrillation in some cases, we must not fail to emphasise in the strongest manner possible the necessity of applying artificial respiration at once to every subject rendered unconscious by electric shock. All those who are likely to be exposed to the risk should be told this, and all those who work in the vicinity of electrical machinery and electric mains should be shown how to apply artificial respiration. The latter should be continued until the recovery or the death of the victim. As a test of death I should suggest the application of the faradic current to any of the limb muscles. The loss of the electric excitability of the muscles is a sure sign of death.

If unconsciousness after electric shock is due to ventricular fibrillation the hope of recovery is small. A medical man must arrive almost immediately and ascertain by stethoscopy and by palpation of the pulse whether the heart is beating. If the ventricles are fibrillating and, in consequence, unable to expel their contents, pulsation of the arteries will not be felt. The only treatment which is likely to restore the normal beat of the heart is massage of the ventricles. It is questionable whether the operation could be done in time or whether the doctor would care to risk its performance. Violent vibration applied to the chest wall over the heart might perhaps have the same effect as massage. If there is the least possibility that it might, it could be applied by one of those electrically driven vibrators used by workers in electrotherapeutics and massage, and one of them could be installed in the factory. The vibrator could be adjusted to give the maximum vibration, or one could be constructed to produce still more violent vibration.

We have not heard anything about the method of ascertaining, beyond doubt, whether the unconscious victim is the subject of fibrillation or whether he has ceased to breathe although his heart is still beating. I presume, without practical experience of the accident in patients or workmen, that the auscultation of cardiac sounds and the discovery of an arterial pulse would exclude the presence of fibrillation of the ventricles.

Sir Bernard Spilsbury's post-mortem observations are very interesting. The injuries which he has observed were, as he says, in and under the skin, and hæmorrhages into the muscles were present in the majority of the cases. His observations favour the view that death is due to cessation of respiration caused by violent stimulation of the sensory nerves.

I may say, then, in conclusion, that Professor Jellinek's insistent demand that all cases rendered unconscious by electric shock should be treated by artificial respiration immediately after the accident is further justified.

Obituary.

PROFESSOR WILHELM KONRAD VON RÖNTGEN died at Munich on February 19th, 1923, at the age of seventy-eight.

Röntgen was born on March 27th, 1845, at Lennep, in the Rhineland. After a preliminary schooling in Holland he studied in Zurich, and went from there to Würzburg in Bavaria, where he collaborated in researches with Professor Kundt. Afterwards, at Strasburg, he carried out measurements on the ratio of the specific heat of gases.

His first professorship was at the Agricultural Academy at Hohenheim, but in 1876 he returned to Strasburg as extra-ordinary professor of physics. Here he carried out several investigations upon the conditions which regulate the passage of electrical discharges through gases at different pressures, but there was little in these researches which could be said to foreshadow the epoch-making discovery which was to follow nearly twenty years later.

In 1879 he went to Giessen, and six years later he occupied the chair of physics at Würzburg, where, ten years later, he discovered X rays.

This discovery was not an accident. It was the result of experiments planned to see whether fluorescence could be got from the electric discharge, and we may well wonder, not only at the long lapse between Röntgen's work on the electric discharge (1878) and the discovery of 1895, but at the researches which had been going on elsewhere which went so perilously near to the same goal. Can we imagine, where others could speak of, the astonishment which the copies of the first radiograph taken at Würzburg and sent to various scientific centres caused to the recipients? This is part of the unwritten history of science, but, strangely enough perhaps, the astonishing features of X rays and their properties continue quite unabated at the present day.

Several played a part in the researches which led to the discovery of X rays, and we may at least suppose that the one who gave the final touch was well aware of this. Plücker discovered the cathode stream in 1859, the study was continued by Sir William Crookes, whose researches into the nature of this phenomenon led him to the conclusion that it was like no other solid, liquid or gaseous manifestation, it was in fact a "fourth state of

matter." How true this surmise was, events subsequent to 1895 were to show. Lenard followed up the work of Crookes, and showed that this cathode stream could, by suitable means, be got outside the discharge tube in which it originates. A year later the X rays were discovered.

If we go back over the electrical discoveries of the century in which this one happened, and look for land-marks perhaps as conspicuous, we might select Oersted's discovery of the magnetic effect of an electric current, a discovery upon which the greater part of electrical measurements are founded; Faraday's discovery of electro-magnetic induction, a phenomenon which makes possible the production of electrical power as we know it to-day; and Hertz's experiments upon electro-magnetic waves following upon the brilliant prediction of Clerk Maxwell, the developments of which have enriched our knowledge of the spectrum on one side of the visible region perhaps as fully as the discovery of X rays has enriched it in the opposite direction. Yet there is no denying the fact that a special hold upon the imagination is felt at the first introduction to the subject of X rays. The fact that the rays penetrate through human tissues is perhaps largely accountable for this, for another degree of vision is realised.

It would be superfluous here to speak of the developments, both scientific and medical which have come from this unique discovery. Curiously enough, it was followed very quickly by another which revolutionised scientific thought even more than did the discovery of X rays, for the spontaneous emission of rays by radio active substances gave a momentary shock to the principle of the conservation of energy, and this shock was felt to an even greater extent by chemists when, in the next few years, it was established beyond all doubt that certain varieties of atoms actually changed into others. If there was a little hesitation on their part to accept the facts, it may perhaps have been due to their loyalty to atomic traditions which had served them well in the past.

Röntgen lived to see a wonderful harvest of the seed which he brought to light. Rewards and honours came to him, but the smile of fortune was the richest gift of all.

S. R.

NOTICES.

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A list of collaborators at home and abroad is being prepared and will be published at an early date. The Editor will be pleased to consider proposals from readers who are willing to assist in the preparation of abstracts from the current literature of the subject.

CONGENITAL IDIOPATHIC DILATATION OF THE COLON.

By DOUGLAS FIRTH, M.A., M.D., F.R.C.P., Junior Physician, King's College Hospital, and KENNETH PLAYFAIR, M.A., M.B., B.Ch. Cantab., Clinical Assistant to Cardiological Department, and late Medical Registrar, King's College Hospital.

CONGENITAL idiopathic dilatation of the colon, with which the name of Hirschsprung is closely associated from his descriptions of it in 1886 and the following years, had been recognised by other observers more than half a century previously. The work of Hirschsprung, however, drew attention to it, and records of cases began to be published with some frequency. In 1902 a masterly review of the subject was written by Finney, who gave some 200 references, and since his paper the literature has become enormous, for the disease, though rare, has features which render recognition easy.

It must be noted that all cases of megacolon recorded are not cases of congenital idiopathic dilatation, for it has long been agreed that enlargement of the rectum and colon may arise secondarily to mechanical obstruction low in the alimentary canal, from such causes as fibrous and malignant strictures and anal lesions; these conditions should not be classified under the heading of Hirschsprung's disease, which is a dilatation and hypertrophy of the large intestine, due to a cause as yet obscure, but apparently congenital in origin. The rectum and the pelvic colon are most constantly affected, but the

descending, transverse and ascending portions of the colon may be involved and even the small intestine.

In this disease, as in all others of obscure origin, sundry hypotheses to explain the causation have been suggested, and these hypotheses may be grouped under four headings :—

1. *Mechanical*.—Comprising torsion or kinking of the gut due to an abnormally long mesentery, or increased length of the sigmoid, atresia of the rectum and anus and valve formation. Instances of megacolon have been recorded due to each of these causes, but a mechanical cause is rare; Barrington-Ward, in the records of nineteen undoubted cases examined post-mortem, could find no evidence of mechanical obstruction, and where such obstruction is found the cases are comparable to the megacolon of adults following a mechanical cause.

2. *Neuropathic*.—Spasm of the circular fibres of the lower part of the intestine due to some nerve defect or irritation. There is some support for this hypothesis in that the muscular hypertrophy does not affect both coats equally; of Barrington-Ward's cases submitted to histological examination "the hypertrophy and hyperplasia of the muscular coats, especially the circular," was the characteristic feature. Dowd, after stating that the walls of the colon are usually hypertrophied as well as dilated, especially the muscular coat, gives microscopical details of two cases, in one of which the longitudinal and circular coats were equal, but in the second the circular coat was three times as thick as the longitudinal. It does not, however, follow that this hypertrophy is due to spasm of neuropathic origin, a point difficult to prove or disprove, and Finney states that in two cases both Meisner's and Auerbach's plexus were normal.

3. *Inflammatory*.—The common finding of a round-celled infiltration of the gut originated this hypothesis, but the inflammation is secondary, and is that seen in any condition where colitis and ulceration of the bowels are present.

4. *Congenital*.—A coincident dilatation and hypertrophy of the colon, as suggested by Hirschsprung himself, a primary hypertrophy with secondary dilatation or *vice versa*, have all been propounded as causes. There is much evidence in favour of a congenital defect, and Finney strongly supports Hirschsprung's conception of the disease, drawing attention to those cases in which dilatation has been present at birth. The early age of onset of symptoms or constipation dating from birth, the marked sex preponderance, and the presence of other congenital abnormalities, as in the case we record, are all in favour of a congenital defect. Barrington-Ward holds the same opinion, and thinks the case recorded by Jorikovsky, of a newly-born child with ectasia of the large intestine, hypertrophy of the whole intestine, and duodenal stenosis, affords conclusive evidence. He considers that the congenital deformity at the lower end of the bowel takes the form of a muscular hyperplasia, which thickens the walls and increases the lumen of the gut, "the physiological functions of the intestine are in abeyance, a block is produced, and the bowel behind for a varying distance, depending on the extent and duration of the

condition, dilates and hypertrophies." He suggests that the condition is comparable to the congenital hypertrophic pyloric stenosis of infants. The ætiology and clinical features are so well known that they only need a brief reference.

Males are more frequently affected than females, roughly in the proportion of 5-1. The onset of symptoms is generally during the first twelve months of life, although in a certain number of cases evidence of the disease does not appear for some years, or rarely until early adult life, but in these cases a careful investigation into the past history reveals long-standing constipation, dating as a rule back to birth.

The symptoms are abdominal distension, frequently of great extent, accompanied in some cases by a tumour, due to the faecal mass and visible peristalsis. Attacks of colicky pain, diarrhoea, or constipation alternating with diarrhoea, and in the later stages, emaciation, are generally present, while volvulus is not an uncommon complication. The degree of dilatation of the colon is at times astounding; in one of the cases of Dowd "at least one gallon of semi-solid faeces were removed on the operating table and another gallon drained away in the next two days." This in a girl aged 17 years.

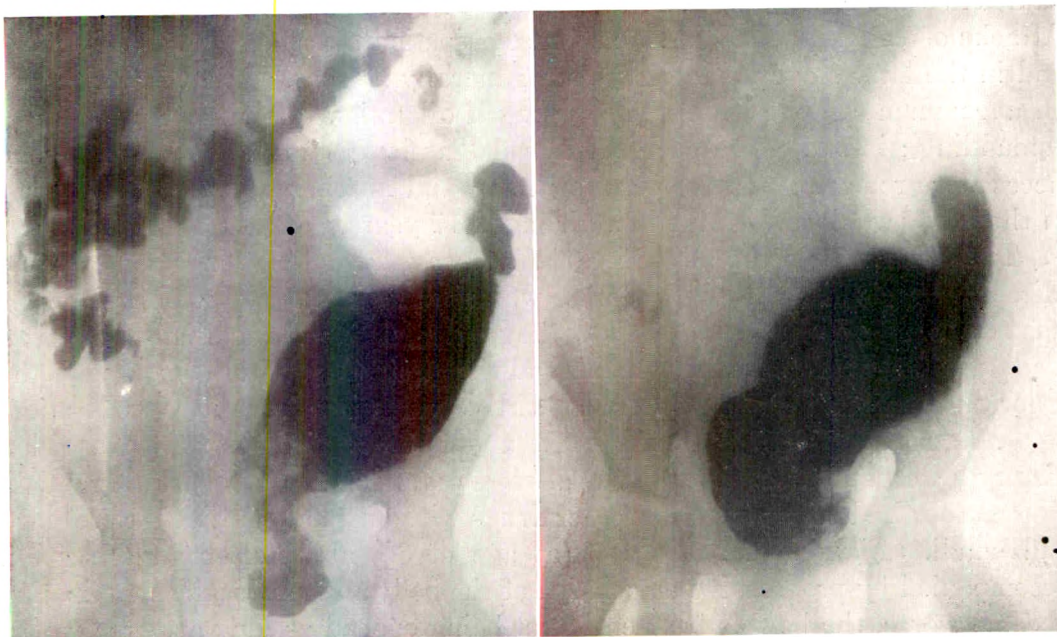
The case now recorded differs in no way from the general picture of Hirschsprung's disease, but, as far as we know, a similar series of radiograms has not been published. They show the gradual filling of the dilated intestine, leading to angulation of the sigmoid, and the falling over from one side to the other of the dilated colon, suggesting why volvulus is a frequent complication.

J. H., male, aged 10 years, first came under observation in May, 1919, with a history of constipation since birth, always requiring oil to obtain a motion. The mother had tried numerous other drugs without result. Stools were hard and small. Eighteen months ago (at age of $8\frac{1}{2}$) abdomen began to swell, accompanied by progressive emaciation of the body and limbs, the constipation became worse, the bowels frequently not being opened as long as three weeks at a time. Attacks of occasional abdominal pain and vomiting appeared. On examination the stools were not offensive. He was sallow, nutrition was fair and the appetite good. The tongue was clean, the abdomen was distended and tympanitic, and a large hard mass was palpated in the left iliac fossa. On examination of the rectum, which was ballooned, a mass of hard faeces the size of an orange was felt. The other organs were normal. Circumference of the abdomen was twenty-three inches. The rectal mass was removed by an enema. A bismuth meal was given and X-ray observations were made at intervals for twelve days, during which time the bowels were never opened. No abnormality of the stomach or small intestine was detected. The sigmoid and colon contained bismuth within twenty-four hours. The sigmoid and colon became more distended, and later the descending and transverse colon, with a definite kink between the sigmoid and descending colon. Throughout this time he remained well, and the bowels were opened at the conclusion of the observations, by turpentine and soap-enemata, followed later by daily motions under pituitrin hypodermically. The general condition being much improved, aperients were omitted, and a further course of bismuth was given and radio-

grams taken over a period of twenty-two days, during which time no action of the bowels took place. The abdomen became greatly distended, enlarging to twenty-five inches in circumference, and as at this stage the boy began to show signs of discomfort, enemata and pituitrin were repeated and the bowels freely evacuated. He improved under medical treatment and was discharged on July 31st, 1921, in good health with an abdominal measurement of only $22\frac{1}{4}$ inches.

The reproductions of this last series of radiograms are discussed later in this paper, together with the prints.

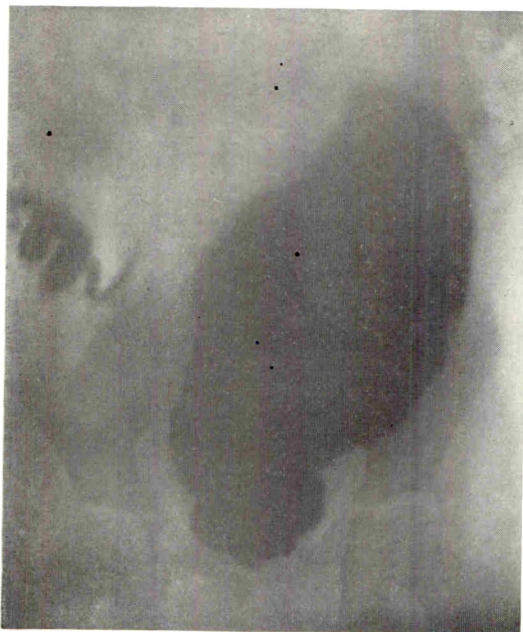
The child remained well for about eighteen months, but at the end of 1920



SKIAGRAM 1.—Taken twenty-four hours after an opaque meal in May, 1919, shows the bulk of the meal in the ballooned upper portion of the sigmoid; small fragmentary masses of the meal can also be seen in the ascending, transverse and descending colon, but these are eclipsed by the amount of the meal in the sigmoid.

SKIAGRAM 2.—Seventy-two hours after the same meal, shows the complete meal in the distended sigmoid colon.

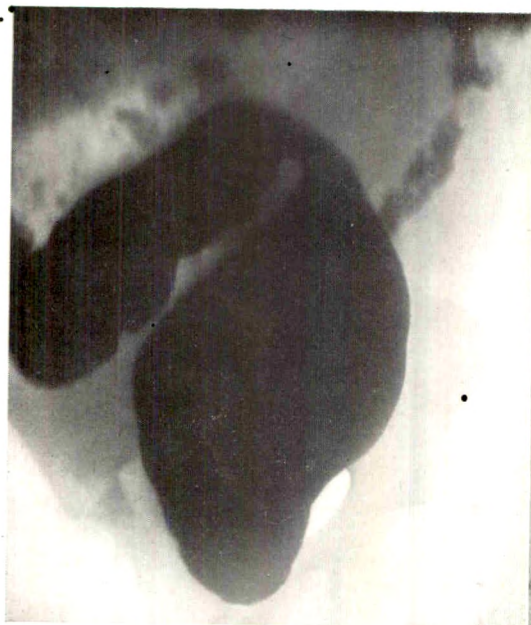
he was admitted to hospital, acutely ill, with great abdominal distension, constipation and attacks of vomiting and colic. These symptoms had begun two months previously. Emaciation was marked (weight, 3 stone, 8 lb., 1 oz.). The abdomen was enormously distended and tympanitic. The subcostal angle was wide and the thoracic viscera were pushed up, but functioned normally. The breath was foetid and tongue furred. After vigorous medical treatment the bowels were opened freely. The faeces were putty-like, grey, offensive and enormously bulky. The great abdominal distension being somewhat reduced, the abdominal contents were further examined by palpation. Visible peristalsis was seen passing from right to left across the abdomen above the umbilicus. A large mass was felt rising out of the pelvis in the middle line,



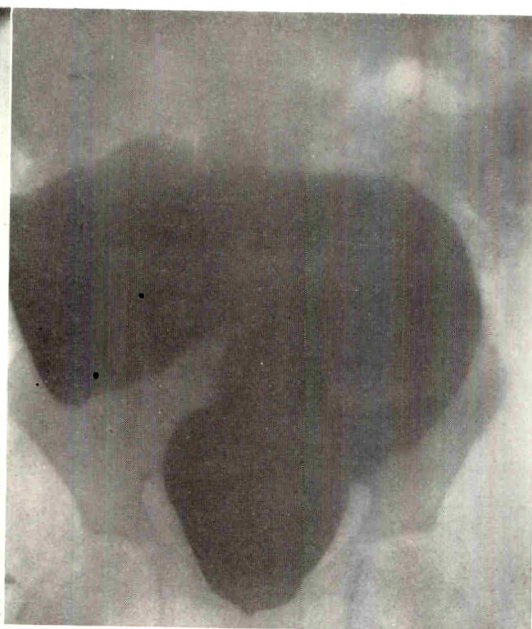
SKIAGRAM 3.—This was taken twenty-four hours after a second opaque meal had been administered, and six days after first meal. No evacuation of the bowels had taken place since the former meal had been given. Nearly the whole of the pelvic cavity and left iliac fossa are occupied by the very distended sigmoid colon. A slighter residue can be seen in the cæcum.



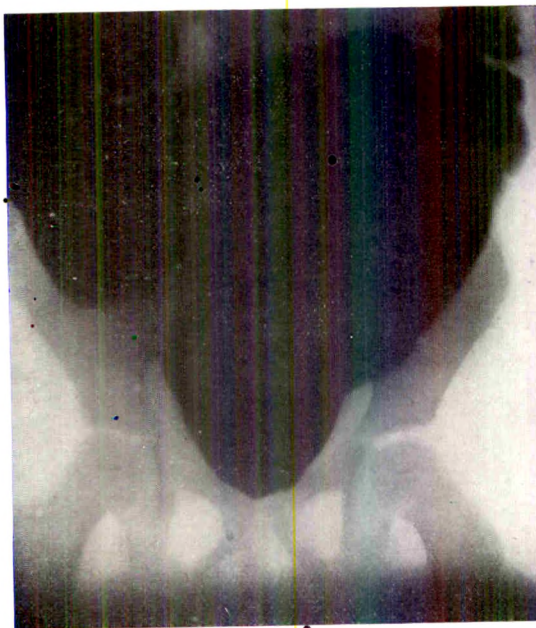
SKIAGRAM 4.—Taken five days later, shows the whole of the opaque material in the distended sigmoid and upper portion of rectum.



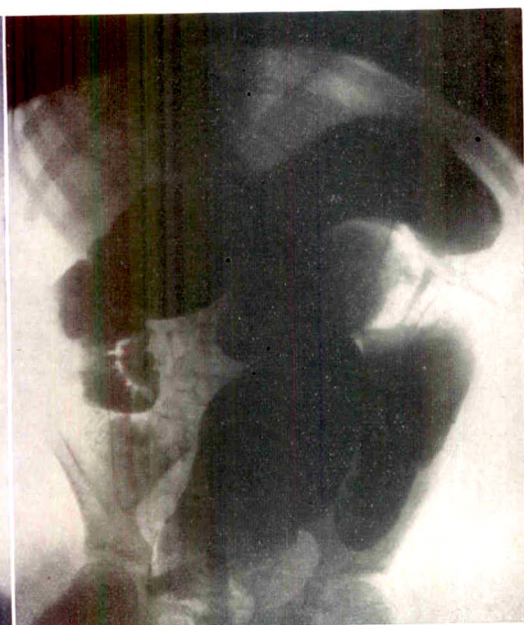
SKIAGRAM 5.—Taken three days later, shows the opaque material in the sigmoid loop of the colon and upper portion of the rectum.



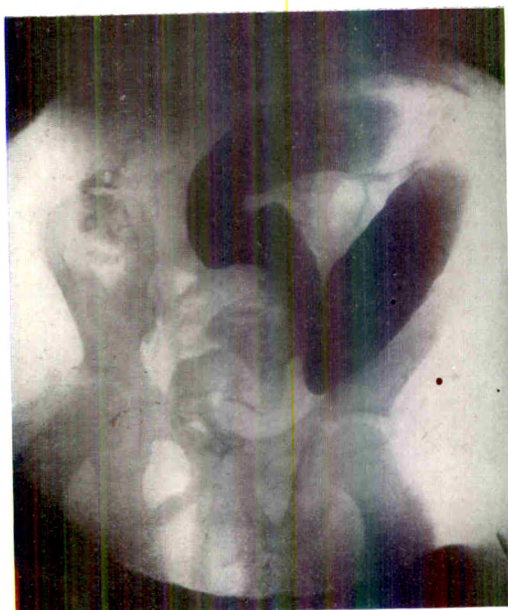
SKIAGRAM 6.—Taken four days later, presents a similar but exaggerated appearance to Skiagram 5.



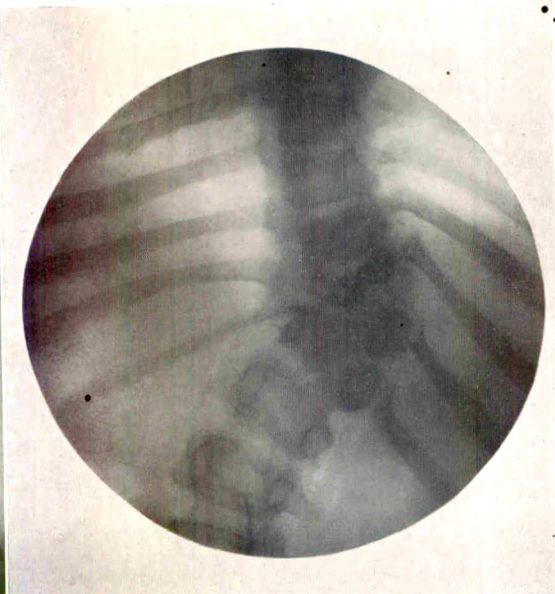
SKIAGRAM 7.—Taken twenty-four hours after a third meal. No evacuation of the bowels having taken place since before the first opaque meal was given. It shows an enormously distended rectum and sigmoid colon containing the whole quantity of the three opaque meals.



SKIAGRAM 8.—Taken in January, 1921, two years later, immediately after an opaque enema had been given. It demonstrates clearly the enormously distended rectum and sigmoid colon. Some of the injected material can be seen as far up as the cecum. The catheter can be seen in the rectum.



SKIAGRAM 9.—Taken immediately after the opaque material had been allowed to siphon off. Still shows marked distension of rectum and sigmoid colon.



SKIAGRAM 10.—Showing lateral curvature of spine due to absence of development of left half of body of tenth dorsal vertebra.

passing up to the left hypochondrium and right iliac fossa. On manipulation of this mass, firm contractions of the gut were set up, giving a sensation of rhythmic muscular contractions. The rectum was distended and contained a mass of faeces (weighing 7 oz.), removal of which, under an anæsthetic, was followed by two large and free evacuations, similar to previous description.

Bismuth enemata were given and radiograms taken confirming the position of the gut found on palpation. Under further medical treatment he improved rapidly and was discharged (weight, 3 stone, 9 lb., 11 oz.).

He attended the hospital at irregular intervals for nine months and was then admitted again for further treatment and observation.

On admission, 20th October, 1921, he looked well nourished and fat, no symptoms were present, and the bowels were open daily with infusion of senna. The rectum was, however, full and distended with a large soft mass of faecal matter, and the distended rectum and sigmoid could be palpated rising out of the pelvis in the middle line to a point above the umbilicus and five inches above the symphysis pubis.

Enemata opened the bowels and marked diminution of the mass felt per rectum followed. A bismuth enema was then given to investigate the condition of the sigmoid and rectum, which were found to be still capable of great distension.

Three weeks after admission the rectum contained a mass of hard faeces, which were removed by oil enemata without difficulty.

He was very fit and well while under observation and has been leading a normal active life since his last admission. His weight is now 4 stone, 7 lb., 14 oz., i.e., a gain of practically one stone during the past ten months.

He has a sharp angular scoliosis due to a congenital mal-development of the left half of the body of tenth dorsal vertebra, as shown on Plate 10.

It is interesting to note in this case the association of congenital idiopathic dilatation of the colon with the defect in the osseous system. It is a well known fact that congenital defects of the central nervous system are frequently associated with deformation of the skeletal system. Wakeley suggests that possibly the dilatation of the colon may have been related to some imperfection in the development of the splanchnic nerves given off at the level of the half-vertebra.

REFERENCES.

- Hirschsprung, *Jahrb. F. Kinderheilk*, 1888.
Finney, *Surgery, Gynaecology and Obstetrics*, 1908, Vol. VI, No. 6.
Barrington-Ward, "Congenital Enlargements of Colon and Rectum," *British Journal of Surgery*, Vol. I, No. 3, 1914.
Dowd, "The Surgical Treatment of Megacolon," *Annals of Surgery*, October, 1921, Part 346, pp. 472 *et seq.*
Tanner, A. H., "Megown Dilatation of the Colon simulating Hirschsprung's Disease," *Journal of Surgery, Gynaecology and Obstetrics*, Vol. XXXIV, No. 2, 1922.
Turtle G. de B., "Spasm in the Alimentary Tract," *Lancet*, I, 361, 1922.
L. Sencert and R. Simon, "Deux Cas de Mégacolon guéris par Colectomie," *Archives Franco-Belges de Chirurgie*, October, 1921.
E. R. Flint, "A Case of Megacolon," *British Medical Journal*, p. 310, 1922.
C. P. G. Wakeley, *Journal of Anatomy*, January, 1923.

FURTHER DEVELOPMENTS IN THE SPECTROMETRIC METHOD OF MARCH, STAUNIG AND FRITZ, FOR THE DETERMINATION OF THE QUALITY OF X RAYS.

By Dr. KONRAD STAUNIG, Innsbruck, Tyrol.

(Translated by W. E. SCHALL, B.Sc.)

I. THE PHYSICAL PRINCIPLES OF THE METHOD.

A new spectrometer for the simple measurement of the wave-length of X rays was described by March, Staunig and Fritz in the February, 1922, number of the *Archives* (Vol. XXVI, page 285). The spectroscopic principle on which this instrument is based is, in the main, as follows:—

The beam of X rays is passed through a crystal, which can be rotated. The internal atomic planes of this crystal resolve the beam into a spectrum, which is observed on a fluorescent screen. This resolution, which is due to interference, takes place in accordance with the laws discovered by Laue and Bragg, in such a way that, for every angular position of the crystal, a certain definite wave-length is picked out from the primary beam, provided, of course, that this wave-length in question is present in the primary beam. The X-rays are passed through narrow slits in two sheets of lead before reaching the crystal, and therefore the wave-length which is picked out appears on the screen as a fluorescent line to right or left of the central undeviated ray.

The brightness of this line is quite sufficient to permit of its being observed for purposes of measurement in a dark room by an eye which has become adapted.

Rotation of the crystal causes every wave-length which is present in the primary beam to show up on the screen in succession—that is to say, the spectrum of the X-radiation is produced. The fluorescent line therefore wanders across the screen when the crystal is turned, and its position at any particular moment nearer to or further from the central ray is determined by the short or long wave respectively which the angular position of the crystal picks out. One can repeat the process of resolving the primary beam into its spectrum as often as one wishes, and so examine the range of that spectrum. In doing so one gets the same impression as he who for the first time sees the light of the sun resolved into a coloured spectrum by a prism. The comparison with the spectrum of the sun's rays becomes intelligible when we bear in mind that in the case of the X-ray spectrum, for a particular position of the crystal, only one wave-length of the radiation appears as fluorescent line at a time, whereas in the visible spectrum all wave-lengths from red to violet appear at once. The X-ray spectrum appears as the visible spectrum would appear if a movable diaphragm between the prism and the observer were to allow but one colour to reach him at a time. The particular wave-lengths in the X-ray spectrum differ from one another only in intensity, i.e., in brightness.

of the fluorescent line, whereas those of the visible spectrum differ in colour as well.

Before coming to the main point, we must understand and grasp these primary principles of the spectroscopic phenomena, for this understanding is essential to the purpose of spectrum analysis, namely, the measurement of the spectrum and also to the utilisation of the results obtained by such measuring.

The reader has probably received the impression by now that this brief summary of spectrum phenomena has already led him into a region of very complicated matters, and that the question of measurement of such phenomena is more difficult still. We can, however, assure him that this is not the case, that the attendant difficulties have been overcome, and that such measurements can be made by a novice after very short experience. This unexpected simplicity in the obtaining of spectrometric results (measurements of wave-length) is the consequence of far-reaching laws in the behaviour of X-radiation which have been discovered by physicists.

We come into contact here with the exact scientific basis of X-ray spectrum analysis, namely, with a series of facts which we must briefly examine. Goethe wrote that "Nature is more simple than we imagine but too tangled to be understood." Science, however, has unravelled the tangle of phenomena so far as this particular subject is concerned, and the simplicity of the X rays has become apparent. The facts in question are:—

1. The discovery by Duane and Hunt that the continuous spectrum of X rays from an X-ray tube has a sharply defined edge at the short wave-length end. The wave-length of this edge is known as the boundary wave-length or minimum wave-length, and is denoted by λ_0 .

2. The discovery by Duane and Hunt that, starting from this boundary wave-length λ_0 , the intensity of the succeeding longer wave-lengths first rises abruptly to a maximum and then gradually dies away towards the long wave-length end (see Fig. 1.)

3. The discovery by Ulrey that the curve of energy distribution throughout the continuous X-ray spectrum shown in Fig. 1 is the same for all anticathode metals.

4. The explanation by March of the law governing this last fact. The heterogeneous beam which is produced by every X-ray tube is due to the conversion of electronic energy into X rays during collisions between electrons and atoms, and March showed by means of the quantum laws of Planck and Einstein and the theory of probability that the energy distribution shown in Fig. 1 must result.

5. The discovery by Duane and Hunt that the boundary wave-length λ_0 is proportional to the voltage which is applied to the X-ray tube, the relationship

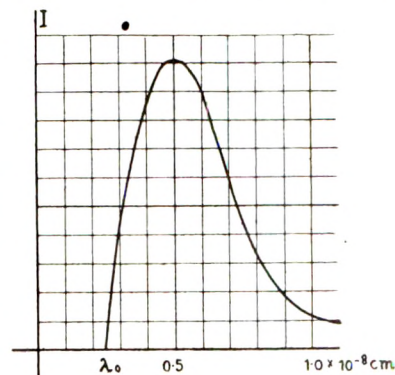


FIG 1.

being such that the product of λ_0 and V is a constant (12380). When the voltage is raised, the boundary wave-length, and, with it, the energy distribution move towards the shorter wave-lengths. When the voltage is lowered they move the other way.

From these facts, we see that the boundary wave-length λ_0 is the factor which characterises the whole X-ray beam. Every beam is qualitatively defined by its λ_0 , and such definition is much more exact and at the same time more simple than have been those of the penetrometers hitherto in use. We have, therefore, found the key for practical X-ray spectrometry, and the duty of the latter is to determine the value of λ_0 in a simple way and with sufficient exactness—thereby determining the quality of the radiation.

The importance of this achievement is clear. The quality of the rays is of paramount importance for the success of an X-ray photograph. The quantity of rays which is necessary for a faultless negative is a matter of lesser importance—and is easily controlled by measuring instruments. Screen examinations also require the use of rays of the correct wave-length.

The question of X-ray therapy is however the most burning of all. The rays are a medicament producing local and general reactions. The correct dosage of this medicament implies that we measure it exactly both qualitatively and quantitatively. So long as we do not know the quality, it is as if we were dealing with a medicine of which we do not know the composition. Nobody would wish to prescribe such a medicine, even though he might have the means of measuring it quantitatively in c.cs. But if we can measure the quality of our X rays exactly, and if in separate applications we have used the same quality of rays—then we can rely on it that, the geometric conditions being the same, equal skin doses will have equal depth doses. By geometric conditions we mean the focus skin distance, the area of the skin window, and the depth at which the depth dose is measured. We can put this another way by saying that the dose at a depth which we want to measure depends on: (1) the quality of the rays; (2) the skin dose; (3) the area of skin window; (4) the focus skin distance; (5) the depth of the object below the skin. So long as any one of these factors cannot be measured, complicated empirical methods must be used to determine the depth dose. Now that we can measure them all, tables have been drawn up which show the depth dose at a glance. In other words, it has become possible to produce a new and simple method of dosage in deep therapy based on spectrometric measurements.

The measurement of the voltage of the secondary circuit is also considerably facilitated by the determinations of X-ray wave-lengths. The law of Duane and Hunt shows that there is a simple relationship between difference of potential and the boundary wave-length. Consequently, we can determine with accuracy the voltage which is generating an X-radiation when we have measured its λ_0 . This voltage which actually produces the radiation is, however, the only one which interests the operator. Measurements of voltage on the equivalent spark gap or the kilo voltmeter are useless if we do not know

with certainty what radiation they produce. And this is just what we have been unable to do up to the present, because, on the one hand, these voltages are exposed to such great losses—especially the high voltages—between the secondary terminals, where the equivalent spark is measured, and the tube. And, on the other hand, we must remember that the tube is a transformer of energy, and can make use of the applied voltage only up to a point. Having thus shown the importance of the measurement of the boundary wave-length, we are at once led to consider how this is best carried out.

II. THE TECHNIQUE OF X-RAY WAVE-LENGTH DETERMINATION.

In Fig. 2 we see the general principle upon which the instrument is arranged. The point at which the boundary wave-length of the spectrum occurs is determined by moving a pointer tipped with luminous paint to the spot where, when the crystal is slowly rotated, the moving image of the slit on the fluorescent screen suddenly vanishes. We have learnt that this short wave-length end of the spectrum has been shown by Duane and Hunt to be very sharply defined. The crystal is then rotated still further till the second spectrum, symmetrically placed on the other side of the central ray, flashes up, and a second pointer is adjusted to mark the position of λ_0 on this side. One of the pointers has a scale attached, on which the length of the arc $\lambda_0 - O - \lambda_0$ can immediately be read in millimetres. The dimensions of the whole instrument are so chosen that the distance between the two pointers in centimetres gives the value of the boundary wave-length λ_0 of the radiation—in tenths of an Angstrom unit ($1 \text{ A.U.} = 1 \times 10^{-8} \text{ cms.}$).

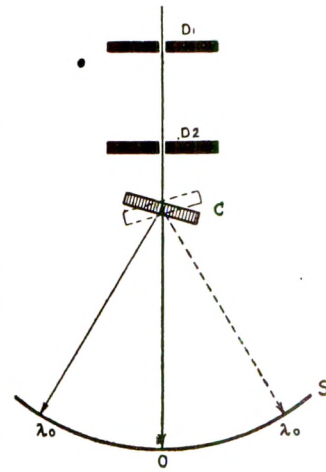


FIG. 2.

Thus, if the distance between the two pointers when placed on the boundaries of the two spectra for a particular radiation is 2.8 cms., the λ_0 of that radiation is 0.28 Angstrom units.

Hitherto the method of X-ray spectroscopy has been entirely in the hands of the physicist, who employed it in crystallography and other avenues of research far removed from medicine. His object is the elucidation of the laws of nature, and thereby to open up fresh fields for applied science. His apparatus is, of necessity, very exact, and his methods are complicated and difficult.

The work of the radiologist, on the other hand, requires that he should be able rapidly to obtain sufficiently accurate data concerning the quality of rays which emanate from his X-ray tubes under various conditions of primary and secondary current, etc. In making this spectrometric method applicable to practical radiography we have therefore employed the fluorescent screen as the chief means of measuring wave-lengths, and the results of years of

experiment have proved that the readings obtained have an accuracy which is amply sufficient for the purpose. At the same time, the instrument is so made that a photographic method can be used where yet more accurate information is desired.

Every method of measurement, when applied to practical ends, adapts itself to the requirements of the situation. Just as a pharmacist needs an accurate but not too accurate balance for the dispensing of medicines, so the requirements of practical radiology are satisfied if the boundary wave-length can be determined to the nearest 0.01 A.U. At the same time, we have so constructed the apparatus—as described below—that photographic determination of the value of λ_0 can be made if desired, thus giving a still greater accuracy.

III. TECHNICAL DETAILS OF THE INSTRUMENT.

The first batch of instruments was made in Innsbruck, and the design was adapted to the conditions under which we work there. The most efficient

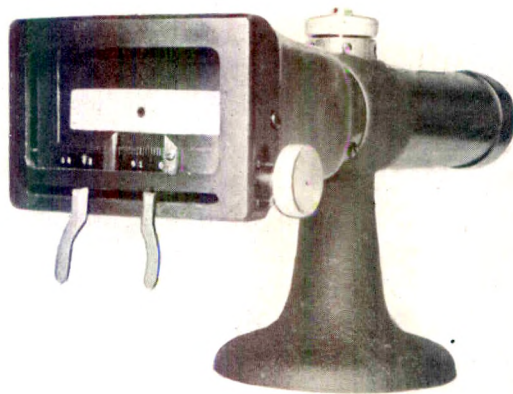


FIG. 3.

apparatus which we have will give, at its maximum output, a peak voltage of 140,000 volts. The radiation under these conditions has a boundary wave-length λ_0 0.09 Angstrom units. Since then we have made several changes and improvements—notably as regards protection and the general construction.

The instrument is wholly encased in lead, which is 8 mm. thick on the front where the diaphragms are situated, and 5 mm. thick round the sides. The fluorescent screen itself is covered with plate lead glass 8 mm. thick. The spectrometer must be employed behind a protective screen lined with 3 mm. lead, in which there is a small hole $\frac{3}{8}$ in. in diameter to allow a beam of rays to pass. Experiments on the most modern deep therapy plants in Frankfurt have shown that this amount of protection is sufficient.

The external appearance of the instrument is that shown in Fig. 3. The tube of the instrument itself is lined with lead.

On testing the instrument, we found that we could measure conveniently up to 200,000 volts, for which purpose we used 2 milliamperes in hot cathode tubes. This corresponds to 1 milliampere in gas tubes (since the quantity of X rays per milliampere of current is double in the case of a gas tube as compared with a hot cathode tube). We employed an anticathode-screen distance of 60-70 cms.

IV. DEVELOPMENT OF THE SPECTROMETRIC METHOD.

We mentioned above that in the interests of rapid work we must adhere to the simplest method of measurement—which involves darkening the room and the necessary adaptation of the eye. Every radiologist is accustomed to screen work and to adapting his eyes to darkened rooms, and therefore the observation of detail on the fluorescent screen is no new method.

In ordinary radiological practice the human body is examined on the screen, and frequently such examinations suffice for diagnosis and report. Sometimes a photograph is made in addition, either for more careful study subsequently, or for reporting purposes, or both. In just the same way the screen examination of the position and dimensions of the boundary wave-length suffices in most cases. In order, however, to enable operators to obtain a record, and to have a means of checking the observation of their eyes, we have arranged the instrument in such a way that the boundary wave-length position can be photographed.

The principle upon which this has been done is the following:—

We know already that for each position of the reflected line on the fluorescent screen there is a definite position of the crystal. Consequently, we can determine the boundary wave-length or any other wave-length, not merely from the distance between the two symmetrical positions of the fluorescent line on either side of the central ray (see II), but also from the angular position of the crystal. We therefore fitted a finely divided scale with vernier to the milled head by which the crystal is rotated. And, moreover, we arranged a film holder which could be slipped in immediately behind the fluorescent screen.

In this way we could:—

1. Determine the value of λ_0 from readings of the angular position of the crystal.
2. Take a photograph of a part of the spectrum produced by any particular position of the crystal.

The advantage is that independently of the darkening of the room or the adaptation of our eyes, we can obtain yet more accurate information regarding the position of λ_0 . The photographic method is applied when we want accurate results at the highest voltages at which one works. In these regions it is necessary to read the position of λ_0 to the nearest 0.5 millimetre, and this is not entirely easy by eye. Having found what we believe to be λ_0 on the screen, we set the instrument to a wave-length which is a little shorter still, and take a photograph on a dental film to see whether any radiation is present. If not,

then our ocular measurement was correct. But if a line is obtained on the photograph, then the rays had a shorter λ_0 than we had read, and the vernier readings on the angle scale of the crystal give it to us.

Each exposure requires about two milliampere minutes at 60 cms. focus crystal distance, and with a hot cathode tube. Even with this method, therefore, the determination of what λ_0 a certain tube will give under certain conditions is a matter of a few minutes only.

REMARKS ON PYELOGRAPHY AT A LANTERN DEMONSTRATION BEFORE THE CONGRESS OF RADIOLOGY AND PHYSIOTHERAPY.

By Sir JOHN THOMSON-WALKER, Senior Urologist, King's College Hospital.

The early and accurate diagnosis of many diseases of the urinary organs depends upon the advances made in your speciality. Of these, pyelography is one of the most important.

There is a period in the history of hydronephrosis when the kidney cannot be felt on abdominal palpation.

At this time the distension is moderate, little destruction of kidney tissue has resulted, and no infection is present. Removal of the obstruction will save the kidney almost intact, and it is at this time, therefore, that the diagnosis should be made.

At this period the patient suffers from recurrent attacks of abdominal pain.

Examination of the abdomen may show a movable kidney, or an X-ray examination may show a stone in the renal pelvis, and in these cases there is no difficulty in making the diagnosis and recommending treatment. But there is usually no movable kidney, and the X rays show no stone shadow, and the urine is free from blood and infection.

In such a case an accurate diagnosis can only be made by pyelography.

Pyelography consists in filling the renal pelvis and calices with a fluid opaque to the X rays and obtaining a radiogram.

Various solutions have been used. When I published the first article on pyelography in this country, eleven years ago,* collargol was the opaque solution used.

Collargol (Voelcker) threw a very opaque shadow, which has not been improved upon by any of the fluids subsequently introduced. But there were serious objections to its use.

Fatal accidents occurred and were recorded. These were partly due to clumsiness and inexperience on the part of the surgeon, but partly to intrinsic defects in the solution, namely: (1) local destruction of the tissues, and (2) absorption and poisoning. Moreover, the solution was dirty and inconvenient to use.

* *Lancet* 1911. 1927.

A neutral solution of thorium nitrate (15 per cent.) was next introduced by Burns. There were, however, difficulties in the accurate preparation of the solution, and it was shown by Weld, in discussing a fatal case at the Mayo Clinic, that thorium nitrate solution became increasingly toxic the longer it was kept.

Sodium bromide (20 and 25 per cent.) and sodium iodide are the solutions now in use.

The shadow shown by these solutions is not quite so dense as those of collargol, but it is sufficiently dense to give satisfactory results.

Sodium bromide has many advantages: it is cheap, is unchanged by boiling and can therefore be sterilised, and it is clean.

I have used it constantly since April, 1920, and it was used in all the radiograms here shown.

I am a little doubtful in regard to its irritating properties, especially in solution higher than 20 per cent. I have seen irritation of the renal pelvis and inflammation of the apices of the pyramids that I ascribe to the use of a solution of 30 per cent. strength.

Undoubtedly it is very irritating in the bladder.

There are certain points that I consider important in the technique of pyelography:—

1. The examination must be carried out without a general anæsthetic. This enables the patient to indicate to the surgeon when the renal pelvis is full. Distension of the renal pelvis causes pain, which will increase to a colic if the distension is continued.

2. Previous experience in catheterisation of ureters is necessary. I cannot too strongly insist that this is not a method to be used by the occasional cabbler in urology. Destruction of the kidney and even a fatal accident has resulted from inexperience and lack of care.

3. The fluid in the renal pelvis must be withdrawn before introducing the opaque solution. This is done by suction with a syringe, connected with the ureteral catheter by means of a small appliance, which will fit almost any catheter and any syringe.*

Neglect of these precautions accounts for some failures, for the injection of opaque fluid into a pool of retained urine gives a poor shadow.

4. The opaque catheters should be of moderate size, so as not to completely fill the ureteric lumen. This is a partial safeguard against overfilling the renal pelvis, for some of the fluid soon escapes alongside the catheter.

5. The catheter is passed until it is arrested, and is then withdrawn one centimetre. The reason for this is that the point of the catheter, in a normal pelvis, always enters the upper calyx, and if the fluid is injected with the eye in the calyx the pelvis may only be partly filled, when pain is felt by the patient owing to the distension of the calyx.

6. The patient lies on the back with the couch inclined, so that the head is

* This appliance has recently been ascribed to a French source. It was introduced by the author and illustrated in his Hunterian Lectures in 1907.

low. The inclination of the couch is not essential, but it assists in retaining the fluid in the pelvis in those cases where it tends to flow out too rapidly.

7. The radiologist has the plates and tubes in position before the pelvis is filled, and is ready, without any moving of the patient and without a moment's delay, to make the exposure. This I consider of the utmost importance. One factor in the production of irritation of the renal pelvis and kidney by the opaque fluid is the length of time the solution remains in the pelvis. In some cases the fluid escapes rapidly down the ureter, alongside the catheter. Delay caused by the radiologist producing his plates and getting them into position and bringing his apparatus into alignment will, therefore, lead to some failures, and further, it carries an element of danger. Further, provision must previously have been made for exposure of additional plates without delay.

8. The injection is made slowly and with a gentle touch. This is the test of the delicacy and touch of the surgeon. For some years, after the publication on the continent of fatal cases due to over-distension of the pelvis, I advocated the use of hydrostatic pressure in introducing the fluid, and I still hold that for those who are gaining experience, and whose opportunities for practice are not abundant, this is the safest method. For those who are frequently using the method, and who are alive to its dangers, a syringe is preferable.

9. When pain is felt in the kidney the injection is stopped. I have elsewhere pointed out that as the hydronephrosis advances the pain of distension diminishes, and further, there are some patients with strangely insensitive renal pelvises. These facts should be borne in mind in gauging the distension by the presence of pain.

10. When the exposure has been made, the fluid is removed from the renal pelvis by suction. This is quite a simple matter with the use of the connecting apparatus to which I have referred. It conduces, I believe, to the safety of the method. Where a further exposure may become necessary after development of the plates, the fluid should be removed from the pelvis and reintroduced when required. I am sometimes asked how much compression is permissible. With the precautions taken above, whatever compression is considered necessary for the radiogram may be made. But the patient, after the pelvis of the kidney has been filled, should not be turned over and made to lie on a cushion. This courts failure by the delay and the movement, which tends to empty the renal pelvis of the opaque fluid, and moreover, it is impossible to limit the pressure thus produced, which is only measured by the weight of the patient.

READING A PYELOGRAPHIC PLATE.

We have long ago passed the stage when pyelography is used to demonstrate a greatly distended renal pelvis and kidney. The fully developed hydronephrosis may be diagnosed without pyelography.

What we want is to try and recognise the early changes shown by pyelography before destruction of the kidney tissues is advanced, and this can only be done by accuracy in reading the pyelographic plates.

I have elsewhere* laid down five essential points for the correct reading of a pyelographic plate :—

1. *The Shape and Lie of the Pelvis.*—The normal pelvis is trumpet-shaped and is set vertically on the upper end of the ureter, and from it the calices project laterally and antero-posteriorly.

2. *The Shape and Appearance of the Calices.*—The normal calyx had a short neck and expanded end, which is cup-shaped. In the hollow of the cup lies the apex of the pyramid. Calices seen end-on appear as rounded darker patches near the outer border of the shadow of the pelvis. Usually, most of the calices are seen projecting laterally. Occasionally a number of end-on calices are shown, and they may resemble stone shadows.

3. An opaque catheter passes from the ureter vertically, or with a slight outward curve into the upper calyx.

4. The upper ureter, the lower margin of the renal pelvis, and the lowest calyx, form a symmetrical curve amounting to half a circle, which I have named the uretero-calicine curve.

5. The expansion of the ureter into the renal pelvis is gradual and there is nothing to mark the point of junction.

CHANGES DUE TO OBSTRUCTION.

1. The earliest changes in the development of hydronephrosis are in the calices.

The cup end of a calyx becomes rounded or clubbed, so that the cupping disappears. The neck is shortened and broadened. In the advanced hydronephrosis the calices are represented by rounded bays projecting from the expanded pelvis.

2. The pelvis begins to show changes in shape. Becomes rounded and may sometimes become almost square. The upper margin is elevated and the lower margin depressed. The over-distended normal renal pelvis should not be mistaken for an early hydronephrosis. It has a rounded appearance that the experienced eye quickly detects.

3. The uretero-calicine curve loses its symmetry and becomes an angle. The angle becomes gradually reduced in size until it almost disappears.

4. The upper wall of the pelvis is pushed upwards and the line of the ureter and upper calyx is changed. A catheter passed up the ureter will not now enter the upper calyx, but impinges on the roof of the pelvis and raises it up like a tent pole; or the catheter may coil round and double into a loop.

5. Changes at the junction of the pelvis and ureter are observed. The lumen may appear narrowed, or the angle at which the ureter joins the pelvis is altered.

A kink or duplication of the upper end of the ureter may be shown in the pyelogram. This kinking may be temporary or permanent.

Temporary kinking is due to mobility of the kidney and is affected by

* International Congress of Urology, Paris, 1921.

position, appearing in the erect position and disappearing in the horizontal. It does not necessarily cause obstruction.

Permanent kinking is fixed by adhesions and is unaffected by position. It is the cause of a considerable proportion of cases of hydronephrosis.

In any case, whether there is kinking or narrowing or not, the transition of the ureter into the renal pelvis is sudden and pronounced.

OTHER USES FOR PYELOGRAPHY AND URETEROGRAPHY.

1. *The Localisation of a Supposed Stone Shadow in the Kidneys.*—It is an advantage, in operation upon a case of small calculus in the kidney, to know exactly where to look for the stone. Without the use of pyelography a fairly accurate localisation is possible in a plate of good quality which shows the kidney shadow. We can say, from the relation of the stone shadow to the kidney shadow, whether the stone lies in the pelvis or in a calyx, and if the latter, whether it is an upper, middle or a lower calyx. Pyelography will only increase the accuracy of the localisation.

But there is a fallacy in regard to this accurate localisation. A small stone is often freely movable. It has a free entrance and exit to the calices and pelvis, all of which may be a little dilated. Only yesterday I operated on a patient with two small shadows close together in the middle calices of the kidney, and, on searching the kidney, I found one in a lower calyx and the other at the entrance to an upper calyx.

2. *The Staining of Translucent Calculi by means of Opaque Solutions.*—Some years ago, with the late Dr. Ironside Bruce, I tried to stain with collargol calculi in the kidney which threw a light shadow, in the hope of using this to stain uric acid calculi, if these were suspected to be present. We were unsuccessful, however, and I do not know of any further work in this line. Fortunately, pure uric acid calculi are among the rarest forms of kidney stone.

3. *The Localisation of a Shadow in the Renal Area.*—With the greatly improved technique of radiography a new difficulty for the urinary surgeon has arisen. Gall stones are now being demonstrated on the X-ray plate and shown in the renal area or near to it.

Pyelography will demonstrate the exact position of the renal pelvis and calices and their relation to a shadow in such a doubtful case. If the shadow does not lie over that of the renal pelvis or calices, we may conclude that it is extra-renal, for, in my experience, every calculus of the kidney is either in the pelvis or in a calyx, and a stone embedded in the cortex apart from a calyx does not exist.

Another method of differentiation of gall-stone shadows is lateral radiography, and lateral pyelography, and I shall turn to that presently.

4. *Pyelography in the Diagnosis of Abdominal Tumours.*—The cases where difficulty arises are those where there are no localising characters (such as a notch) or localising symptom (such as hæmaturia or jaundice).

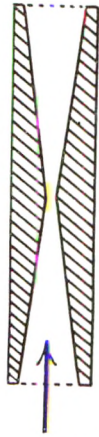


FIG. 1.—Syringe connection.



FIG. 2.—Incompletely filled hydronephrosis due to catheter engaging in upper calyx. Calices filled with solution.

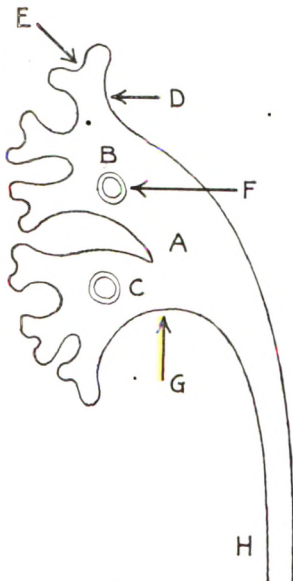


FIG. 3.—Normal pelvis and calices.

A Pelvis. B C Upper and lower divisions. D Neck of calyx. E Cup of calyx. F End-on calyx. G Uretero-calicine curve. H Ureter.

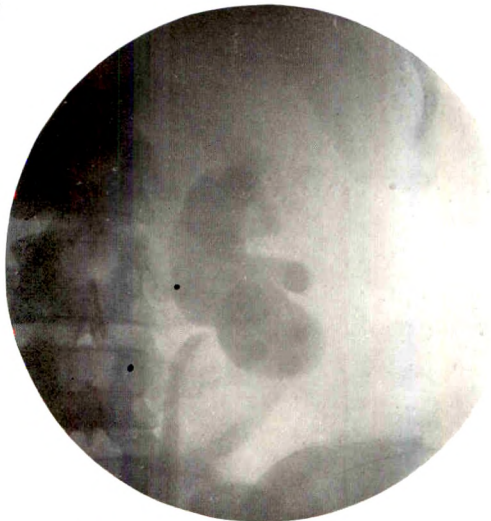


FIG. 4.—Pelvis with end-on calices.



FIG. 5.—Catheter in upper calyx.

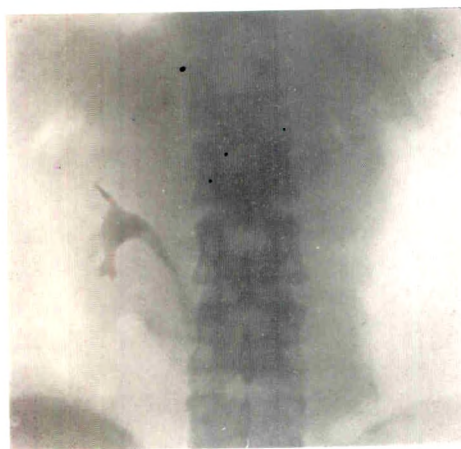


FIG. 6.—Catheter in upper calyx.

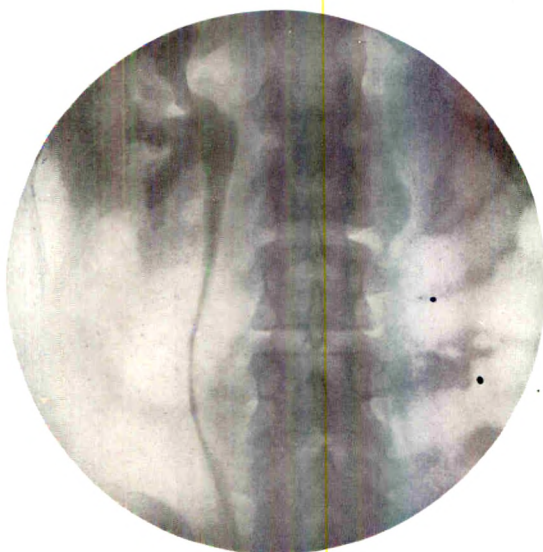


FIG. 7.—Dilatation of upper calyx with catheter.

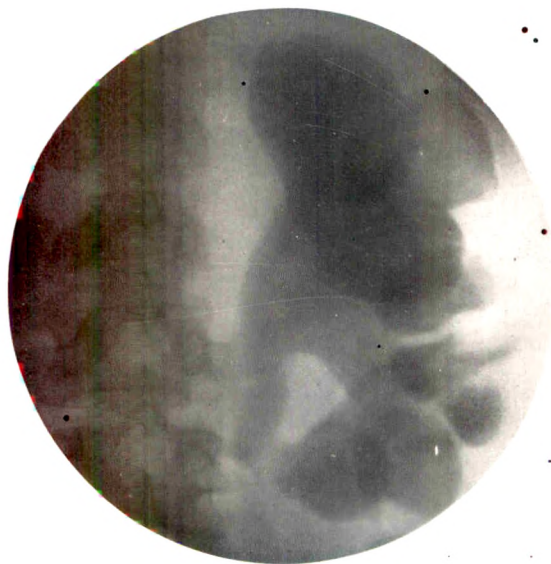


FIG. 8.—Advanced hydronephrosis.

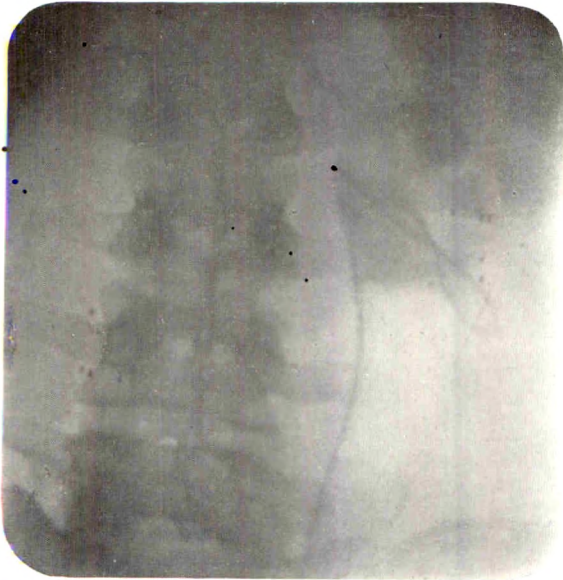


FIG. 9.—Catheter coiled inside pelvis.

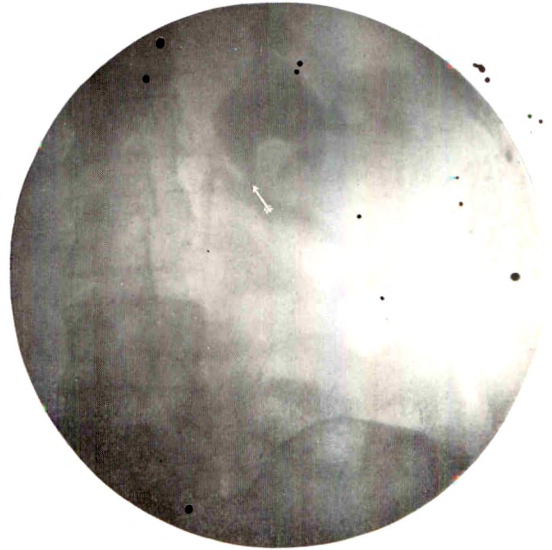


FIG. 10.—Kink at uretero-pelvic junction.

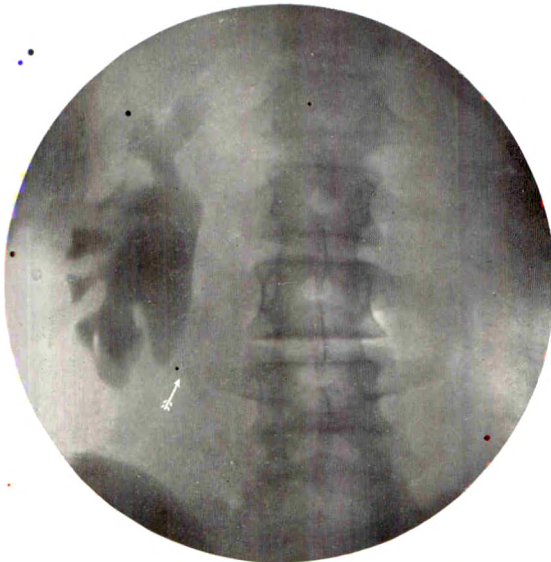


FIG. 11.—Kink at uretero-pelvic junction.

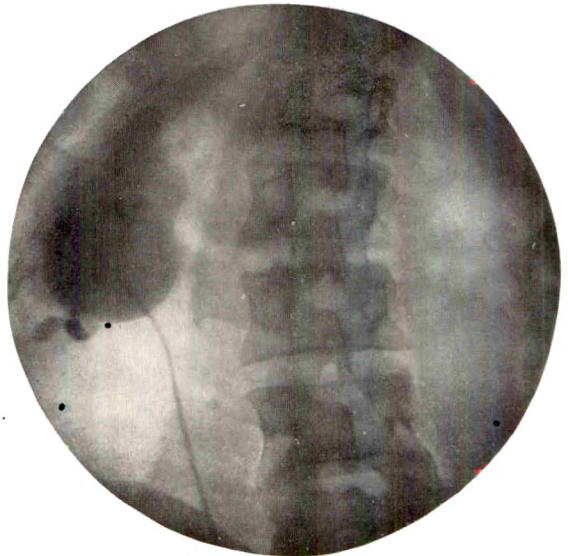
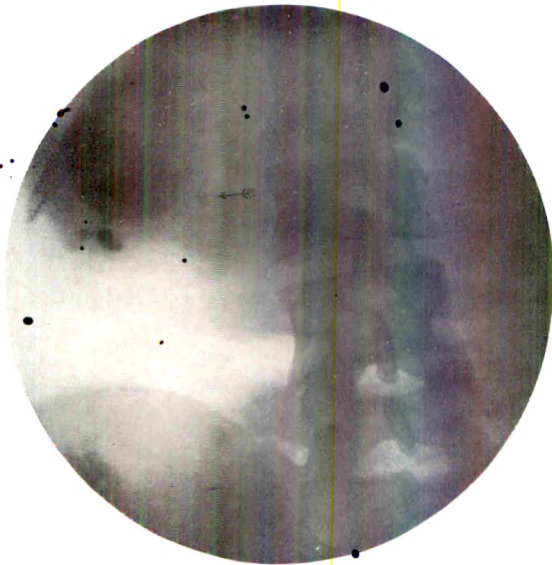


FIG. 12.—Hydronephrosis, pelvic type, due to obstruction of bismuth plugs.



13.—Same case, catheter withdrawn and plug lying in upper ureter.

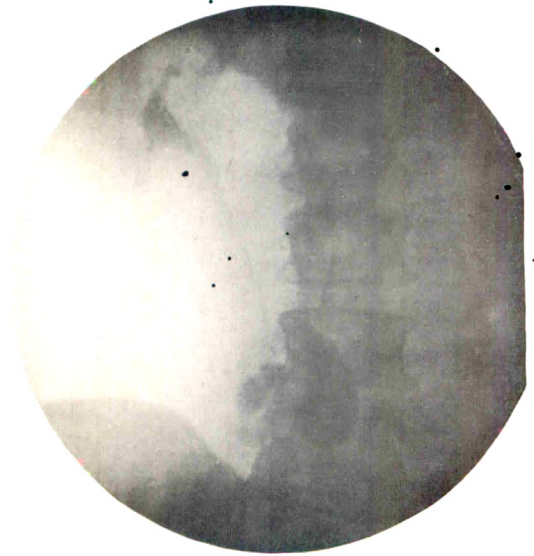


FIG. 14.—Pyelography and abdominal gland shadows.

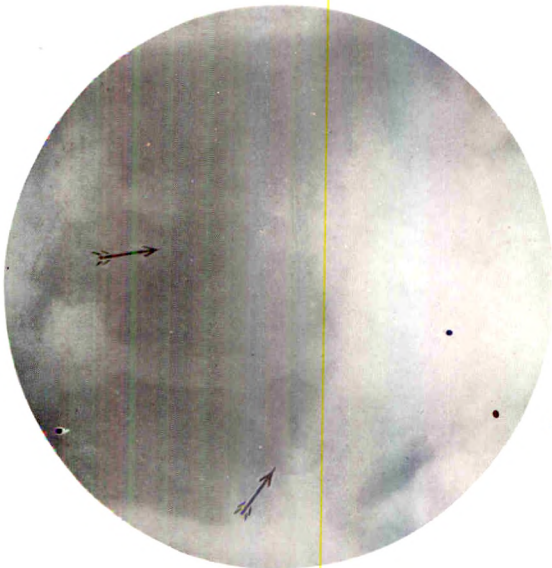


FIG. 15.—Lateral radiography, showing kidney stone and gall-stone.

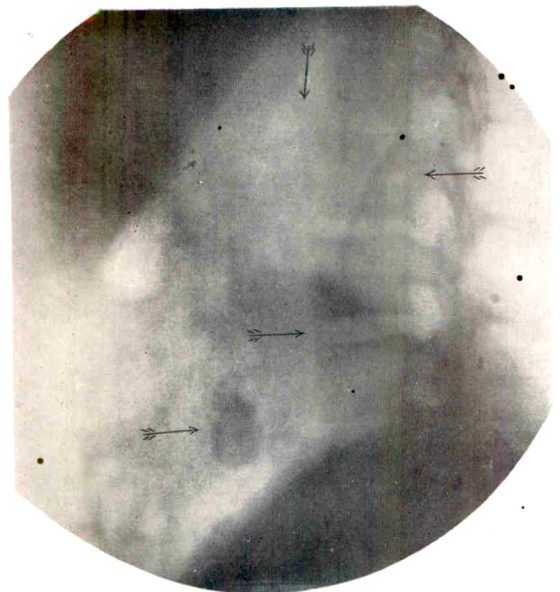


FIG. 16.—Lateral pyelography, showing calcified abdominal glands.

The renal pelvis and calices may be shown to lie at a distance from the swelling. Such cases as the following have occurred in my practice:—

- (a) A mass of abdominal glands in a child.
- (b) Hydatid cysts attached to the liver.
- (c) Recto-peritoneal sarcoma.

5. *The Diagnosis of Renal Growths.*—Braasch states that in over seventy-five per cent. of the kidneys operated on for malignant growth of the kidney, in the Mayo Clinic, pyelography showed a recognisable change in the renal pelvis.

The cases when this would be important would be cases of symptomless unilateral renal hæmaturia. I have not been able to get the help from pyelography in these cases which Dr. Braasch claims.

LATERAL RADIOGRAPHY AND PYELOGRAPHY.

In addition to the usual antero-posterior view of the kidney and ureter, a lateral view may be taken, where a stone shadow has already been demonstrated or after an antero-posterior pyelogram. The kidneys lie in a recess on either side of the spine.

The shadow of the kidney pelvis lies in the shadow of the bodies of the second and third lumbar vertebræ. It is an elongated oval, narrowing below to the ureter. The calices are spread out laterally from the pelvis, the upper pointing upwards like two horns and the lower downwards.

The ureter passes forwards from the lower extremity of the pelvis and reaches the anterior margin of the bodies of the vertebræ at the level of the fourth lumbar vertebra.

The shadow of a stone in the pelvis, or in one of the calices, lies on the shadow of the vertebræ.

Where the stone lies at the extremity of a calyx, near the surface of the kidney, the shadow may lie behind the body of the vertebræ. Where the stone is of great size, or there is a collection of stones with a much enlarged kidney, the shadow or shadows project beyond the anterior margin of the bodies of the vertebræ. With these exceptions the stone shadow will be found on the shadow of the vertebræ body.

With improved modern technique gall stones are frequently shown on the X-ray plate, and the shadow or shadows lie in the right renal area of an antero-posterior radiogram. With a lateral view, the gall-stone shadows lie well in front of the bodies of the vertebræ and are usually lower down, apart from the character of the shadows.

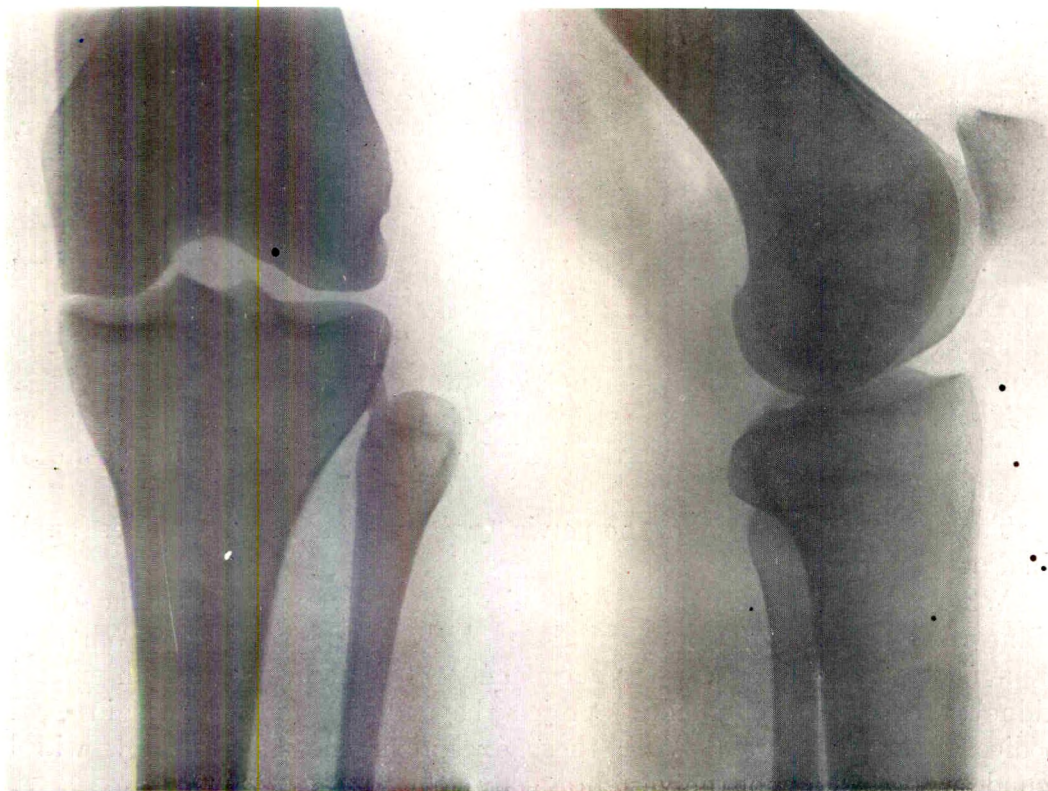
There are, therefore, two methods by which a gall-stone shadow may be distinguished from one thrown by a kidney calculus, namely, pyelography and lateral radiography. Shadows thrown by bodies in the colon may be distinguished by lateral pyelography.

Calcified abdominal glands lie anterior to the vertebral shadow and at a lower level than the pelvis of the kidney, and close to the ureter. An opaque bougie in the ureter will demonstrate the relation of this tube to the calcified gland shadow.

DISLOCATION OF THE UPPER END OF THE FIBULA FORWARDS WITHOUT A FRACTURE OF THE TIBIA OR FIBULA.

By R. H. SANKEY, M.B., B.Ch. (Oxon), M.R.C.S., L.R.C.P., Hon. Radiologist to the Radcliffe Infirmary, Oxford.

I AM indebted to Mr. Dodds-Parker for permission to record this case, which I venture to think is a very uncommon accident. The patient, a medical



student, fell off his bicycle owing to a skid. He had an abrasion over the tubercle of his tibia, and patella. Exactly how he fell, he does not remember. It was easily reduced under gas

UNIVERSITY OF CAMBRIDGE.

Examination for the Diploma in Medical Radiology and Electrolology.
April, 1923.

The following Candidates have satisfied the Examiners in Part I (Physics and Electrotechnics):

Affi, Mahmoud Ahmed
 Bodas, Narayan Mahadev
 Bowen, John Edmund
 Clarke, Burnett Leslie Woodburn
 de Glanville, Lionel Richard Gethin
 Frizell, Malcolm
 Grellier, Norman
 Hastings, William Howitt (*Trin.*)
 James, Joseph Frain
 Joshi, Mahadev Dattatraya
 Kellock, Anna Taylor

Knight, Jane Stobo
 Luyt, Gabriel Julian
 MacLeod, Alexander Gordon
 Moir, Margaret Jane
 Rajan, Huggahalli Sundara
 Ross, Alexander
 Rowden, William Henry
 Sheret, Jessie Evelyn
 Twining, Edward Wing
 Warden, Sorab Byramji
 Whitby, Edward Vernon

E. RUTHERFORD
 J. A. CROWTHER
 SIDNEY RUSS } *Examiners.*

20th April, 1923.

The following Candidates have satisfied the Examiners in Part II (Radiology and Electrolology):

Affi, Mahmoud Ahmed
 Barker, Eric Gordon
 Bowen, John Edmund
 Clarke, Burnett Leslie Woodburn
 Hodgson, Harold Kingston Graham
 James, Joseph Frain

Knight, Jane Stobo
 Rajan, Huggahalli Sundara
 Rowden, William Henry
 Thierens, James Pearson
 Twining, Edward Wing

A. E. BARCLAY
 E. P. CUMBERBATCH
 F. SHILLINGTON SCALES } *Examiners.*

20th April, 1923.

CURRENT LITERATURE.

The X-ray Diagnosis of Accessory Sinusitis.—J. G. VAN ZWALUWENBURG (*Am. Jour. of Roent.*, January, 1922, Vol. IX, No. 1, pp. 1-10).—Deals mainly with pathology. Advocates stereoscopic radiograms taken sagittally, with a long cone not exceeding five inches diameter, and with a longitudinal shift.

Diagnosis of Pulmonary Conditions in Children.—J. W. PIERSON (*Ibid*, pp. 11-14).—

Deals briefly with X-ray findings in bronchopneumonia, tuberculosis, persistent thymus, and rickets.

Unsuspected Dermoid Cyst Diagnosed by Roentgen Examination.—L. EDEIKEN (*Ibid*, p. 15).

The Lumbar Spine and Sacro-iliac Joints.—M. B. PALMER (*Ibid*, pp. 16-19).—Anatomical variations and arthritic changes in the

lower lumbar vertebrae, more especially when associated with lower back pain.

Treatment of Carcinoma of the Thyroid by the Roentgen Rays and Radium.—G. E. PFAHLER (*Ibid*, pp. 20-25).—Notes of ten cases and details of treatment.

Roentgenotherapy of the Thyroid.—A. F. TYLER (*Ibid*, pp. 25-31).

Three Cases of Sarcoma Treated by Radiation.—D. Y. KEITH and J. P. KEITH (*Ibid*, pp. 31-34).

The Superficial Reaction of Radium as a Guide to Dosage.—W. S. NEWCOMET (*Ibid*, pp. 34-41).

Treatment of Brain Tumours by Radiation.—H. K. PANCOAST (*Ibid*, pp. 42-47).—Treatment of thirty-two cases.

Treatment of Primary Carcinoma of the Vagina with Radium.—L. J. STACY (*Ibid*, pp. 48-52).—Treatment of fourteen cases.

A New Type of Applicator for Use with Radium Emanation.—D. QUICK and F. M. JOHNSON (*Ibid*, pp. 53-55).

A Comparison of Radiation Dosages attainable by Use of Radium on and within Tumours.—C. H. VIOL (*Ibid*, pp. 56-57).

The Efficiency of the Bucky Diaphragm Principle.—R. B. WILSEY (*Ibid*, pp. 58-67).—Investigation as to ratio of width and depth of slit.

Signal Light for Bucky-Potter Diaphragm.—J. E. LINDSEY (*Ibid*, p. 67).

The Physics of the X-ray Tube.—G. W. C. KAYE (*Jour. of Roent. Soc.*, January, 1922, Vol. XVIII, No. 70, pp. 15-26).

Investigations of Transformer Rectifying Sets.—M. A. CODD (*Ibid*, pp. 27-44).

Importance of Physics, Anatomy, and Physiology for the Practice and Progress of Electricity and Radiology.—E. P. CUMBERBATCH (*Proc. Roy. Soc. Med.*, December, 1921, Vol. XV, No. 2, Section of Electrophysics, pp. 1-6).

Some Radiological Points concerning the Pleuro-Pulmonary Affections of Infancy.—E. WEILLAND A. DUFORT (*Jour. de Rad. et d'Élect.*, Vol. VI, No. 1, January, 1922, pp. 1-11).—Deals with the varying appearances of the "pneumonic triangle," and with certain transverse shadows and their diagnostic significance.

The Radiography of Congenital Bronchial Fistulae.—R. LERICHE and A. BADOLLE (*Ibid*, pp. 12-13).—Injection of collargol.

Radiological Exploration of the Interlobar Pulmonary Spaces in Pathological Conditions.—M. GILSON (*Ibid*, pp. 14-20).—Co-relation of anatomical and pathological conditions with diagrams and plates.

A Particular Affection of the Vertebral Column simulating Pott's Disease.—J. CALVE and M. GALLAND (*Ibid*, pp. 21-23).—Calcified nucleus in inter-vertebral disc.

Diagnosis of Diaphragmatic Hernia.—BOUQUET, F. MASSELOT and J. DE BEAUJEU (*Ibid*, pp. 24-26).

Some Rare Fractures of the Bones of the Foot (Scaphoid, Cuboid, Cuneiform).—MOREAU (*Arch. d'Élect. Méd.*, Vol. XXXII, No. 472, January, 1922, pp. 5-13).

Notation in Radium Therapy.—S. LABORDE (*Ibid*, pp. 14-23).

Fluorometric Apparatus for Measuring Deep Doses.—D. HUGUET (*Ibid*, pp. 24-26).

The Formation of Pseudo-Cavities of the Lungs.—V. MARAGLIANO (*Radiologia Medica*, Vol. IX, No. 1, January, 1922, pp. 1-5).—Radiological appearances which must be distinguished from actual cavities.

Radiological Study of the Ileo-Pelvic Colon in Tumours of the Uterus and its Appendages.—I. ODESCALCHI (*Ibid*, pp. 5-19).—Deals with the diagnosis of fibroma of the uterus, ovarian cysts, etc., by displacement of the large intestine, as shown by barium enemata.

Is there a Carcinoma Dose in Radiotherapy?—F. PERUSSIA (*Ibid*, pp. 20-25).—Criticises German claims with regard to a universal dose capable of destroying different forms of carcinoma.

High Voltage X-ray Work.—W. D. COOLIDGE and W. K. KEARSLEY, JUN. (*Am. Jour. of Roent.*, February, 1922, Vol. IX, No. 2, pp. 77-101).—Experimental work to show the output of different X-ray tubes working under the same electrical conditions at 127,000 and 200,000 volts, the distribution of X-ray intensity, certain factors in the tubes affecting efficiency, and the results obtained in X-ray output and behaviour of the tube by various types of high-tension apparatus.

The Ultra-violet Ray in the Treatment of Roentgen Ray Telangiectases.—H. A. HAGEN (*Ibid*, p. 101).

Behaviour of the Stomach in Ulcer and Cancer of the Duodenum below the Bulb.—A. W. CRANE (*Ibid*, pp. 102-111).—Detailed report of two cases.

Action of Radium and the X rays on the Blood and Blood-forming Organs.—ISAAC LEVIN (*Ibid*, pp. 112-116).—Experimental work tending to confirm the view that lymphocytes are more sensitive than other blood cells. The importance of the size of the area radiated is insisted on in its general effect on the blood.

Treatment of Glandular Metastases of Carcinoma.—RUSSELL H. BOGGS (*Ibid*, pp. 117-121).—Stress is laid upon the paths of wide dissemination through the lymphatics of the deep pectoral fascia as studied by Sampson Handley.

The Choice of the Best Opaque Meal.—R. PALICOT (*Arch. d'Élect. Méd.*, Vol. XXXII, No. 473, February, 1922, pp. 33-55).—Discusses the opacity and toxicity of bismuth and barium. Prefers the former except for its cost, and gives a formula, *i.e.*, barium sulphate, grammes 150-200 (or bismuth carbonate, grammes 80-100); gum tragacanth, grammes 3; syrup, grammes 60; water to 300 cc.

Atrophy of Salivary Glands with Stoppage of Secretion; Treated and Cured by Electrotreatment.—PÈNE and P. LAMARQUE (*Ibid*, pp. 56-58).—A case of parotitis with absence of secretion persisting thirteen years, treated with rhythmic reversible galvanic current.

Radiological Diagnosis of Tumours in the Left Hypochondrium.—L. MALLET and R. COLIEZ (*Jour. de Rad. et d'Élect.*, Vol. VI, No. 2, February; 1922, pp. 57-67).—Artificial inflation of the stomach and colon, or of the abdomen generally, as a guide to differentiation of enlarged spleen from renal or other pathological conditions. Nine cases.

A Case of Fracture of the Head of the Radius.—COLANERI and DELAY (*Ibid*, p. 68).

Diverticulum of the Lower Angle of the Duodenum diagnosed by Radiography.—R. FEISSLY (*Ibid*, pp. 69-73).

Foreign Body in the Thorax causing Continued Suppuration.—CHAUVIRÉ (*Ibid*, pp. 74-75).—Drainage tube discovered by X rays.

Radiological Investigation of a Volvulus of the Stomach.—A. ROSSELET and R. GILBERT (*Ibid*, pp. 76-80).—Diagnosis of a diverticulum of the stomach associated with ulcer; skiagrams taken in the Trendelenburg position.

X-ray Treatment of Hypertrichosis in Women.—G. SCADUTO (*Radiologia Medica*, Vol. IX, No. 2, February, 1922, pp. 33-43).—Reviews previous work, discusses dangers, and describes technique.

X-ray Treatment of Tubercular Peritonitis.—P. SESSA (*Ibid*, pp. 44-53).—Deals with the beneficial results of X-ray treatment, with ten cases.

A Rare Radiological Finding in the Duodenum.—L. ARMANI (*Ibid*, pp. 53-56).—Describes a case of great dilatation of the first part of the duodenum and its X-ray appearance.

Roentgenological Progress in the Physiology, Pathology, and Diagnosis of the Urinary System by means of X rays.—F. EISLER (*Fortschritte a. d. Geb. d. Roentgenstrahlen*, Vol. XXIX, Part I, March 20th, 1922, pp. 1-20).—Interesting paper dealing with the kidney, ureter, bladder, and urethra by injection, by palpation, by variations in position, etc., as the case requires. In particular, studies the appearance of the bladder when empty, when filling, and when full.

X-ray Measurement of the Pelvis.—WEBER (*Ibid*, pp. 20-33).—Largely mathematical. Advocates stereoscopic methods.

X-ray Determination of the Volume of the Heart.—H. E. LORENZ (*Ibid*, pp. 35-41).—Deals with various orthodiagraphic methods.

"Shadow - summation."—F. PELTASON (*Ibid*, pp. 42-51).—Intensification of X-ray shadows by overlying organs, as evidenced in the emulsion of the plate.

The Relations of the Internal Secretions upon the Genesis of Important Skeletal Variations in X-ray Practice.—H. FISCHER (*Ibid*, pp. 51-56).—Suggests the influence of the genital glands, or of castration upon certain epiphyses, with continuance of growth and deformity of bones, especially as a cause of supernumerary bones. Quotes two cases of supernumerary bones associated with acromegaly.

The Influence of Duplication in Single Bones.—APPELRATH (*Ibid*, pp. 57-59).—

Describes a hand with eight fingers, four normal, and four functioning as thumbs, also with twelve carpal bones, and other abnormalities in the arm.

Stereo-radiography in Intra-pleural, Intra-abdominal, and Diaphragmatic Conditions.—TH. NAEGLI and H. CRAMER (*Ibid*, pp. 59-61).—Gives technique for the above. Abdominal inflation is utilised where required.

Sensibility and Sensitisation in X-ray Therapy.—F. VOLTZ (*Ibid*, pp. 61-80).—Partly theoretical, partly practical. The latter includes pressure, application of heat by diathermy, chemical methods by various injections, optical methods such as injection of fluorescent crystals in paraffin, and secondary radiations, especially after the introduction of copper by electrolytic methods.

Surgical-radiological Diagnostic Errors in

Bone Diseases.—R. KIENBÖCK (*Ibid*, pp. 81-96).—Gives detailed operative or post-mortem cases.

Technical Considerations in the Roentgenology of Children.—H. WIMBERGER (*Ibid*, pp. 96-99).—Methods of obtaining immobility.

Experimental Researches into the Physical Bases of Roentgen Diagnosis.—R. GLOCKER (*Ibid*, pp. 100-120).—Discusses effects of variation of time, wave-length; development, intensifying screens, etc.

On a Peculiar, hitherto Unknown Form of Multiple Epiphysitis.—BRUNO VALENTIN (*Ibid*, pp. 120-125).—Describes an affection of the epiphyses of the lower end of the femur, and the upper and lower ends of the tibia, in a boy of seven, somewhat of the type of Perthe's disease.

NOTES AND ABSTRACTS.

Roentgenological Examinations of the Motility of the Stomach.—AAGE ALS NIELSEN, Copenhagen (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 379-383).—The author has examined twenty stomachs of healthy individuals—ten men and ten women—following the intake of an opaque meal consisting of 300 grammes of rice flour gruel and 100 grammes of barium sulphate. The individuals were partly at rest and partly in motion. He has found that:—

1. The stomach empties quicker during motion than rest.

2. In women the stomach empties somewhat slower than in men, both in motion and at rest.

3. The stomach empties normally at rest within five hours intake of opaque meal.

The Definite Form of the Coxa Plana.—H. WALDENSTRÖM, Stockholm (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 384-394).—The diagnosis coxa plana essentialis can certainly be made only during the evolutionary stage. The definite form can therefore only be studied in cases that are followed from the beginning of the disease.

To endeavour to explain the definite form of coxa plana, I have after-examined those cases of coxa plana where I have been enabled to follow the development from the beginning until the end of the period of growth. There are shown to have been twenty-two hips; ten of these have even attained an age of over twenty years.

The definite form, that I can hereby establish, is shown to be very variable in respect to the degree of the deformity, but the flattening of the caput, collum and acetabulum is common to all.

Through roentgenograms, both from a frontal and lateral view, one can obtain a plastic picture of the form of the caput and collum in the different cases. It can then be seen how it is mainly the anterior-superior portion of the caput that is enlarged, and that this portion, in the more pronounced cases, lies outside of the articulation. With respect to the degree of the deformity, I have divided the definite coxa plana into three groups:—

1. The caput preserves a rounded form. The caput and the collum can be well dis-

tinguished from each other and from the trochanter. Figs. 3*d* and 9*b*.

2. The upper and frontal part of the enlarged caput lies close to the greater trochanter. This portion of the caput is seen in the lateral picture, greatly enlarged, lying outside of the articulation. The upper part of the collum is not seen. Fig. 4*d*.

3. The joint-surface of the caput is uneven and more or less excavated. The upper pole of the caput is edge-formed and usually lower than the summit of the greater trochanter. Figs. 5*d*, 6*b* and 7.

A Study on the Roentgen Aspect of Tuberculosis of the Joints and its Relation to the Clinical Aspect, especially when under Treatment by Universal Light Baths.—EDVARD COLLIN, København, (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 395-405).

1. Even if the roentgen aspect reveals no sign of tuberculous changes, it does not exclude the possibility of the affection being tuberculous. "Histories," Nos. 7*b*, and 11.

2. Sometimes the roentgenological changes only come at a moment when the clinical symptoms have considerably improved ("Histories," Nos. 7*a* and 7*b*), as first emphasised, I think, by Ernst.

3. The light treatment of surgical tuberculosis can yield extremely fine results, even where serious roentgenological changes are found, for which reason one cannot, on the basis of these alone, give a bad prognosis; because even very large destructions may be repaired with light treatment. "Histories," Nos. 2, 3, 5, 6, 8, 9, 10, 12.

4. The complete roentgenological healing may occur long after the clinical symptoms have disappeared. "History," No. 12.

5. Tuberculous osteitis can heal spontaneously, but under light treatment the result becomes cosmetically and roentgenologically far nicer, and is attained more quickly. "Histories," Nos. 4 and 12.

6. Simultaneously with clinical improvement considerable roentgenological deterioration is seen at times. In reality this is merely the sign of the diseased material being reabsorbed.

7. Extensive arthritis in hand, ankle, knee, and elbow-joint can heal with new formation of articular cartilage and good function.

8. A joint-end seen deformed roentgenologically can occur simultaneously with a completely free function clinically.

A Contribution to the Roentgenology of the Genuine Mixed Tumour of the Trunk.—

HUGO LAURELL, •Upsala (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 406-417).—The author has collected from the literature a number of roentgenologically examined, positive genuine mixed tumours, localised to the pelvis, mediastium or lungs; besides cases suspected of such. Of these only two could be roentgenologically diagnosed with certainty before the operation, viz., those of Josephson-Söderlund, 1915, and Edeiken, 1922. In both these cases a pelvic dermoid was present, and the finding of dental elements in the wall of the dermoid cyst served to establish the diagnosis. In the other cases the diagnosis was not made until after the operation, or remained uncertain, whilst neither at operation or section could a positive diagnosis be made.

The author shows some roentgen pictures, on the one hand, from a resected pelvic dermoid (not roentgen-examined before the operation), which contained a well developed tooth with a distinct root canal; on the other hand, from a retro-peritoneal teratoma in the superior portion of the abdominal cavity, which he had roentgen-diagnosed in 1919. This latter case is described in detail. The finding of an irregular mass of bone, a cyst fully the size of an orange, and a tooth with visible root canal, enabled him to make his diagnoses.

In agreement with other authors, the writer emphasises the importance of bearing these mixed tumours in mind at the roentgen examination of the inner organs of the trunk, which, thanks to the occurrence of bone and tooth elements, can be diagnosed in a fairly big percentage. Well developed teeth are of particularly great diagnostic value. If the teeth are deformed, however, or for technical reasons or others do not appear distinctly on the plate, then they can occasion misinterpretation. For instance, when shown to be in the urinary tract, they can lead to a diagnosis of concretions in the ureter, as in the cases of Thurstan Holland and Sonntag.

The dental elements can lie quite free in these tumours, or be embedded in a distinct matrix of bone; they can be found isolated or

multiple, deformed or normal. They can appear as permanent or as milk teeth, and at various stages of development. It is important to remember that tooth and bone elements can be found without the coincidental presence of a palpable tumour.

If the mixed tumours contain no bone and tooth elements, then they cannot be diagnosed with certainty. However, it is of a certain diagnostic value if we can prove the shape of the tumour, which is also possible with some of these growths. It is most easily accomplished when they are localised to the thorax, and are surrounded with transparent pulmonary parenchyma, but also possible when found in the abdominal cavity and pelvis. These genuine mixed tumours (dermoid cysts) are mostly of a more or less rounded shape, but other forms of them can have rounded outlines too, at least in part.

On the Roentgen Treatment of Brain Tumours.—S. NORDENTOFT, Aarhus (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 418-421).—A report of nineteen cases of clinically diagnosed tumour of the brain treated by roentgen irradiation. Probably some of them have been cyst, meningitis serosa, etc., not responding to irradiation. Nine of them seem to be cured (some of them with remaining defects, as, for instance, hemianopsia), and are surviving; one of them two and a half years, the others from three and a half to six and a half years after treatment. Through the good effects of irradiation the diagnosis of brain tumour is confirmed.

Results of Treatment of Surgical Tuberculosis with Carbon Arc-Light Baths, at Finsen's Light Institute, from 1913 to 1921.—N. P. ERNST, Copenhagen (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 422-454).—At the Finsen Medical Light Institute, in Copenhagen, on the initiative of Doctor Reyn, "Finsenbaths" (carbon arc-light baths) have been employed since 1913 for treatment of patients suffering from lupus or surgical tuberculosis.

In all, 439 patients suffering from surgical tuberculosis have been treated; 158 cases of uncomplicated tuberculosis, with 145 patients; and 396 cases of tuberculosis complicated with abscess or fistulas, with 294 patients.

The results of the treatment have been remarkably good.

In 158 cases of uncomplicated tuberculosis in joints and bones, twelve have broken off the treatment. Of the rest (146) 122 or 83 per cent. were cured, 88 with free movement, eighteen with partial movement, five without movement. Five were improved and only nineteen were unchanged.

In 396 cases of surgical tuberculosis complicated with abscess or fistulas, twenty-four have broken off the treatment and ten have died under treatment. Of the remainder (362) 332 or 91 per cent. were cured, 255 with free movement, fifty-five with partial movement, and twenty-two without movement. Fifteen were improved and only twenty-five were unchanged.

As regards the results, one may remember that the greater part of the patients are adults (only less than one third are recruited from childhood), and further, many of our patients have been ill for so many years, that *a priori* any thought of recovery had to be excluded. Furthermore, it may be remembered that many of our patients, on account of lack of space and much against our wish, have had to be treated ambulant, and during the treatment they have lived in their extensively poor homes.

The best results are obtained in cases of tuberculosis in hand, foot and elbow-joint, also in all forms of ostitis, both complicated and uncomplicated. The cases, which have proved refractory are the uncomplicated tendo-synovitis, and the very old fistulous bone affections in columna pelvis and coxa.

The Results of our Treatment of Tuberculous Lymphadenitis by Roentgen Rays, at Lund, from 1908 to 1918.—LARS EDLING, Lund (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 455-469).—After having quoted the most important dates in the history of the radiotherapy of lymphadenitis, the author describes the development of the technique of this treatment at the Roentgenological Institute in Lund. Since 1913-1914 this technique is characterised by the method of deep irradiation with aluminium filters of 3 to 4 mm., of secondary filters in gauze, a focus distance of 18 to 20 cm., and doses varying from 1½ to .5 H (larger doses only by exception); for children, on the contrary, generally not exceeding 2 to 3 H. The author himself

maintains a certain reserve in respect to the use of stronger doses, filtered by heavy metal, as to the disease.

From a clinical standpoint he divides the process of the lymphadenitis into three phases, viz., (1) simple hyperplasia of the tuberculous glands; (2) formation of large glandular masses with periadenitis; and (3) suppuration softening with fistulas and scrophuloderma.

The results of the irradiation for these phases are as follows:—

All the observations comprise 206 cases, of which 70 belong to the first phase, 32 to the second, and 104 to the third. A recovery (disappearance or atrophy of the glands with small fibrous remnants) in group 1 has been made in 70 per cent. of these cases, in group 2 in 56, 2 per cent., in group 3 in 84, 6 per cent. An improvement has been made in 20 per cent., 28 per cent., and 5-6 per cent., embracing either cases with diminution of the lymphomata, or those where the treatment was interrupted or not yet concluded. Fourteen cases of recurrences have been recorded (6 to 7 per cent.), of which three are from group 1 and two from group 3. There have been eight deaths. In calculating the total duration of treatment a space has been reached varying from $6\frac{1}{2}$, 8 and 8 to 10 months for the different groups. In the cases belonging to group 1 the treatment has generally yielded a favourable result, unless the lymphomata have already been strongly indurated. The great glandular masses with caseous degeneration take much time to reabsorb. In these cases the limit between groups 2 and 3 cannot be clinically established with certainty, but the gravity of the cases depends on the development observed during treatment, in this sense, that the latter facilitates suppuration, supposing that such a tendency exists. The softening can also occur in solitary and absolutely mobile glands.

In the event of suppuration the abscess is generally treated by incision, radical scraping, and then tamponade for several days, after which the fistula is allowed to close. In suit-

able cases we endeavour to confine ourselves to punctures. If fistulas or scrophuloderma already exist, the treatment begins with scraping. The scars resulting from the incisions are often remarkably fine and equal. The soft lymphomata do not give a bad prognosis in radiotherapy; rather the contrary. A tardy softening can survive up to five years after the ceasing of the treatment.

A comparison with the surgical statistics of the lymphomata shows that the radiotherapy furnishes a much higher percentage (77 per cent. against 54 per cent. after operation), and a lesser number of recurrences (30 per cent. against 28 per cent. of operation cases). On the other hand, the treatment by roentgen rays offers a certain risk of secondary lesions of the skin. The author has observed such in thirty-six cases, of which the half were, nevertheless, of very light nature. These lesions can, however, always be avoided by means of an appropriate technique. More serious lesions, such as atrophy of the skin with teleangiectasia or pigmentation, are not included in the author's observations. By radiotherapy the patient avoids the unpleasantness of a serious operation, and the cosmetic result is often much to be preferred. The excellent results of irradiation show the best advantage in cases where the surgeon has little success (abscess, fistulas).

On the other hand, the radiological treatment suffers from the inconvenience of being of long duration, frequently also combined with tiring and expensive journeys—which is a matter to be taken into consideration when patients with limited means are concerned. Operation is preferable for solitary and mobile lymphomata without softening, as well as for cases where there are great masses of indurated glands that have not been reduced after a certain period of irradiation. A combination of universal light baths is often to be recommended, especially when diffuse, soft or fistulous lymphomata are in question, complicated by tuberculosis of the skin and a bad general condition.

PUBLICATIONS RECEIVED.

Books.

A Cura Dos Fibromas Pelos Raios X. By Dr. E. DE SOUZA, DO O.

Interpretation of Dental and Maxillary Roentgenograms. By R. H. IVY, M.D., D.D.S., and LE ROY M. ENNIS, D.D.S. (Henry Kimpton, 18s. net.)

X Rays. By G. W. C. KAYE, O.B.E., M.A., D.Sc., F. Inst. P. (Longmans Green & Co., 16s. net.)

Atlante Radiografico Dello Sviluppo Delle Ossa Delle Estremita. By Dr. P. SESSA and Dr. O. ALBERTI. (Bologna, L. Cappelli.)

The Spectroscope. By T. THORNE BAKER, A.M.I.E.E., F.R.P.S. Second Edition. (Bailière, Tindall & Cox, 8s. 6d. net.)

Journals.

Archives d'Électricité Médicale et de Physiothérapie, February, March, 1923.

Archivio Italiano di Chirurgia, January, February, 1923.

Acta Radiologica, February, 1923.

American Journal of Surgery, March, 1923.

Bibliographie der Gesamten Inneren Medizin und Ihrer Grenzgebiete für das Jahr 1920-1923.

British Journal of Dermatology and Syphilis, March, April, 1923.

British Journal of Surgery, April, 1923.

Bulletin of the Johns Hopkins Hospital, February, March, April, 1923.

Bulletins et Memoires de la Société de Radiologie Médicale de France, February, March, 1923.

Bulletin Officiel de la Société Française d'Electrothérapie, Jan., Feb., Mar., 1923.

Gazetta Medica Peruana, February, 1923.

Health, April, 1923.

Hospitalstidende, January 24th, 31st; February 7th, 14th, 21st, 28th; March 7th, 12th, 14th, 1923.

International Journal of Orthodontia, Oral Surgery and Radiography, Feb., Mar., 1923.

Journal of Bone and Joint Surgery, January, April, 1923.

Journal of Laryngology and Otology, March, April, May, 1923.

Journal de Médecine de Bordeaux, February 25th; March 10th, 25th; April 10th, 25th, 1923.

Journal de Médecine de Lyon, February 20th; March 5th, 20th; April 5th, 20th, 1923.

Journal de Radiologie et d'Electrologie, February, March, 1923.

Journal of Radiology, March, April, 1923.

Journal of the Roentgen Society, April, 1923.

Kongresszentrallblatt für die Gesamte Innere Medizin und Ihre Grenzgebiete, February 19th, 26th; March 5th, 12th, 19th, 26th; April 2nd, 9th, 16th, 23rd, 1923.

La Letteratura Radiologica Italiana, February, 1923.

Medical Science, March, April, May, 1923.

Medical Journal of Australia, January 13th, 20th, 27th; February 3rd, 10th, 17th, 24th; March 3rd, 10th, 17th, 1923.

New York Medical Journal and Medical Record, February 21st; March 7th, 21st; April 14th, 18th, 1923.

New York State Journal of Medicine, February, March, April, 1923.

Norsk Magazin for Lægevidenskaben, February, March, 1923.

Il Policlinico, February 15th; March 1st, 15th; April 1st, 1923.

Quarterly Journal of Medicine, April, 1923.

La Radiologia Medica, Feb., Mar., 1923.

Roentgenologia, 1923.

Surgery, Gynaecology, and Obstetrics, February, March, April, 1923.

Traitement de la Tuberculose Irienne par les Rayons X.

Ugeskrift for Læger, February 15th, 22nd; March 8th, 22nd, 29th; April 5th, 19th, 1923.

Urologic and Cutaneous Review, March, 1923.

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ELEVATION OF THE DIAPHRAGM. UNILATERAL PHRENIC PARALYSIS. A RADIOLOGICAL STUDY, WITH SPECIAL REFERENCE TO THE DIFFERENTIAL DIAGNOSIS.

By J. M. WOODBURN MORISON, M.B., C.M., Hon. Assistant Radiologist, Royal Infirmary, Manchester; Lecturer Applied Anatomy—Radiological, Manchester University.

INTRODUCTION.

My thesis is mainly a radiological study of elevation of the diaphragm, with some observations on the differential diagnosis. I have added to the title that of unilateral phrenic paralysis for two reasons; firstly, I hope to show during the course of this paper that certain forms of congenital elevation of the diaphragm are probably due to a unilateral phrenic paralysis, and secondly, to present for consideration a number of cases in which paralysis of one or other leaflet of the diaphragm was caused by a definite pathological lesion involving the phrenic nerve in its passage through the thorax.

Elevation of the diaphragm may be permanent or temporary, and permanent elevations may be congenital or acquired.

Under the heading Permanent Elevation of the Diaphragm we may place Petit's "Eventratio Diaphragmatica," which, as I shall show later, may be either congenital or acquired. The majority of cases of unilateral phrenic paralysis are also placed under this heading and are acquired.

the fact that both the herniae of the diaphragm which he had seen were on the left side. His confrères told him that all those which they had seen were likewise on the left side. This led him to suggest that the convex surface of the liver protects the right side of the diaphragm.

The two cases which he described were in adult males, and clinically of long standing.

The first case was one of true diaphragmatic hernia, in which, at the post-mortem, a great part of the stomach, a portion of the colon, and part of the omentum had passed through a defect in the dorsal part of the left diaphragm into the thorax. There was no hernial sac and there were no adhesions.

The second case was also on the left side, and Petit states that he considered it to be a congenital abnormality. At the post-mortem, on opening the chest, he found a tumour, the size of "a small gourd," formed by a portion of the stomach, colon and omentum, and enclosed in a hernial sac which was formed by peritoneum, diaphragm and pleura. A "thick lymph" of recent origin had caused adhesions to the lower lobe of the lung, and the contents were similarly held together, so that when removed from the sac they kept the shape of the whole tumour.

The death of this patient was attributed to "inflammation of the abdomen."

It is thus seen that Petit clearly recognised that his second case was of a different type from the usual diaphragmatic hernia, and to it he gave the name "Eventratio Diaphragmatica." Since his time about thirty cases have been recorded. In the early days it was a pathological description, but since the introduction of X rays in the study of medicine, and more especially of recent years with the advance of radiology, it has become possible to accurately observe and diagnose these cases during life.

GENERAL DESCRIPTION.

It is generally accepted that the term Eventratio Diaphragmatica should be applied to those cases of congenital origin in which there is a diffuse relaxation of one half of the diaphragm, so that it extends high up into the thorax, forming a sac which contains a portion of the stomach and sometimes a part of the colon and mesentery. All the cases recorded have been on the left side, with the exception of one by Eppinger, in 1911.

In these cases physical examination may determine varying and anomalous signs at the base of the left hemithorax, and also an alteration in the position of the heart, but the radiological examination makes it possible to interpret these signs and arrive at a correct diagnosis.

The screen examination presents a striking picture, the elevated diaphragm, extending high up into the chest, forms a dome, enclosing an air space, at the bottom of which there is often a sharply defined horizontal line of free fluid, on which waves and ripples can be produced by palpation of the abdomen. The presence or absence of this horizontal line depends on the amount of food in the stomach, but the level of this line is always that of the cardiac orifice.

The upper boundary of the dome gives the appearance of a bow line, which extends as an unbroken line across the left hemithorax, and is maintained in all positions. It is formed by the thinned-out diaphragm. If there are no adhesions to the lung, then the movements of the bow line (the relaxed, thinned-out diaphragm) are reversed during the respiratory act, moving upwards with inspiration and downwards with expiration. To this phenomenon the term "paradoxical respiratory movement" has been given. It is usually stated that no movements of the bow line occur, or if any movements were observed that they were synchronous with those of the normal leaflet.

I cannot agree with this, having found in all my cases reversed movements, although in one case only after adhesions to the lung had been divided and until they reformed.

The thinned-out diaphragm having little or no muscular tissue in it, being merely a fibrous structure covered on the one side by peritoneum and on the other by pleura, cannot contract, and so is subject to the mechanical forces of respiration. During inspiration, when the normal right leaflet of the diaphragm descends, the increased intra-abdominal pressure tends to push the inert left leaflet upwards. If, however, the elevation of the diaphragm is high, then the air sac of the stomach enclosed by the dome is correspondingly large, and takes up by the elasticity of the air a good deal of the upward pressure during inspiration. Thus the movements may be very slight, but if present they are reversed.

The contents of the dome vary. The air sac of the stomach is always present, and may occupy the whole of the dome. At times a portion of the colon may be found lying alongside it, and may cause a slight irregularity of the bow line on account of a different pressure of gas in the colon from that in the stomach.

The question as to whether lung tissue could or could not be seen through the clear air space of the dome has been looked on by some as of importance, and Giffen states that it is absent in cases of elevation. I have seen it quite definitely in most of my cases.

It probably depends on the development of the left lung. In many recorded cases the lower lobe of the left lung has been imperfectly developed. This will explain the conflicting statements on this point.

Part of the heart shadow is usually seen through the air in the dome. The heart may be displaced to the right, and in some of the cases recorded this has evidently been a marked feature. It is, however, more a rotation of the heart than a displacement. The term dextro-cardia has been used by some writers, but these cases are not true congenital transpositions to which I think the term dextro-cardia should be restricted.

In all these cases the chest wall is well developed, and it is difficult to detect by observation a difference in the movements of the two sides, but there is a real difference in the expansion of the right and left sides of the chest, of which I have graphic records and which I shall describe in detail later on.

The condition of the stomach requires special consideration, as it has not previously been described.

In nearly all these cases there is a well-marked deformity of the stomach. It is due to the ascent of the greater curvature of the stomach under the elevated diaphragm, with rotation on more or less fixed points. The stomach presents two sacs, the upper spilling forward into the lower. The rotation may be so great that a volvulus is produced which may require surgical interference. In many of the cases recorded there is a history of stomach trouble.

Thus it is seen that in the radiological examination of these cases the following points require consideration :—

1. The bow line in the chest.
2. The contents of the dome.
3. Lung tissue seen through the dome.
4. Movements of the bow line.
5. Level of the stomach contents.
6. Palpation of the abdomen.
7. Displacement of the heart.
8. Development and movements of the chest wall.
9. The deformity of the stomach.

RECORDS OF SIX CASES. GROUP I.

These cases are so much alike, that it would be mere repetition to give them all in full detail. I therefore give a complete description of the first case, and a short account of the others, emphasising the particular points to which I desire to call attention.

CASE 1. In January, 1920, a schoolgirl, A. O'B., aged 12 years, was brought to hospital, having had a cold and cough for two weeks.

The family history was unimportant, and there was nothing to suggest the condition found at the X-ray examination.

The screen examination of the chest showed a complete regular dome on the left side, extending as high as the level of the third rib in front, and enclosing an air space through which, in the upper part, lung tissue was seen. At the bottom of this air space there was a sharply defined horizontal line of fluid, on which waves and ripples were produced by palpation of the abdomen.

No definite movements of the bow line in the chest were observed during respiration, although on one occasion I thought there was a slight reversed movement, an upward movement during inspiration and a downward movement during expiration, but I was not quite confident of this. The dome of the right diaphragm was at the level of the tenth dorsal vertebra. Its movements were normal. The heart was slightly displaced to the right. There was an increased density of the root shadows of both lungs.

On giving a bismuth meal, the food was held up at the cardiac opening of the oesophagus, the lower third of which was dilated; the obstruction was soon overcome, and the stomach was seen to fill in an irregular manner. The cause of this was apparent when the patient, who up to this stage had been examined in the postero-anterior position, was placed in the right anterior oblique position. There were two sacs, the shadows overlapping in the postero-anterior position. The upper sac, when filled, spilled in a forward direction into the lower.

The pyloric end of the stomach was directed backwards and was not well formed. There was no delay in emptying. In the lying down position the bismuth meal passed up to the top of the bow line in the chest, displacing the air and completely filling the dome, which was not altered in position. Nothing abnormal was detected in the small intestine. The colon was well outlined, and the splenic flexure was found to rise alongside the air cap of the stomach to the top of the bow line in the chest, but not beyond it. At other times the whole of the dome in the chest was filled by the air cap of the stomach. A barium enema confirmed these observations on the colon, which was otherwise normal. This was evidently a case of Petit's Eventratio Diaphragmatica.

Mr. John Morley, F.R.C.S., operated by the thoracic route, and from his notes I have extracted the following: "The fundus of the stomach was seen projecting up into the thorax far above the level of the incision. It was at once apparent that a transparent layer of thinned-out diaphragm formed a covering for the elevated abdominal viscera and separated them completely from the true pleural cavity. To the highest point of this thin translucent diaphragm the base of the left lung was firmly adherent. These adhesions were fibrous and vascular, and were readily divided. The diaphragmatic sac was now incised. On opening it the splenic flexure of the colon and left extremity of the great omentum and the greater curvature of the stomach were presented. These were quite free from adhesions. The upper pole of the spleen also came into view. The whole diaphragm was merely represented by a thin sheet, consisting of pleura above and peritoneum below, with some rather dense fibrous tissue between. A partial excision of this diaphragmatic sac was determined upon, with the object of bringing down its level as near to the normal as possible, and so reducing the distortion of the stomach and allowing more expansion of the lungs." Convalescence was uneventful and rapid.

Four weeks after the operation I made another X-ray examination of this case. The lung was fully expanded, the bow line in the chest was not so high, its movements were quite free but reversed, and the stomach presented a more normal appearance, the exaggerated "cup and spill" formation having disappeared. Subsequent examination showed that the movements of the bow line became less and less free; finally, no movements were observed, adhesions having evidently reformed. Microscopical sections of the piece of diaphragm removed showed normal endothelium on the pleural and peritoneal surfaces, and between these dense fibrous tissue with no sign of muscle fibres. No nerve fibres could be made out in sections that were specially stained to show them.

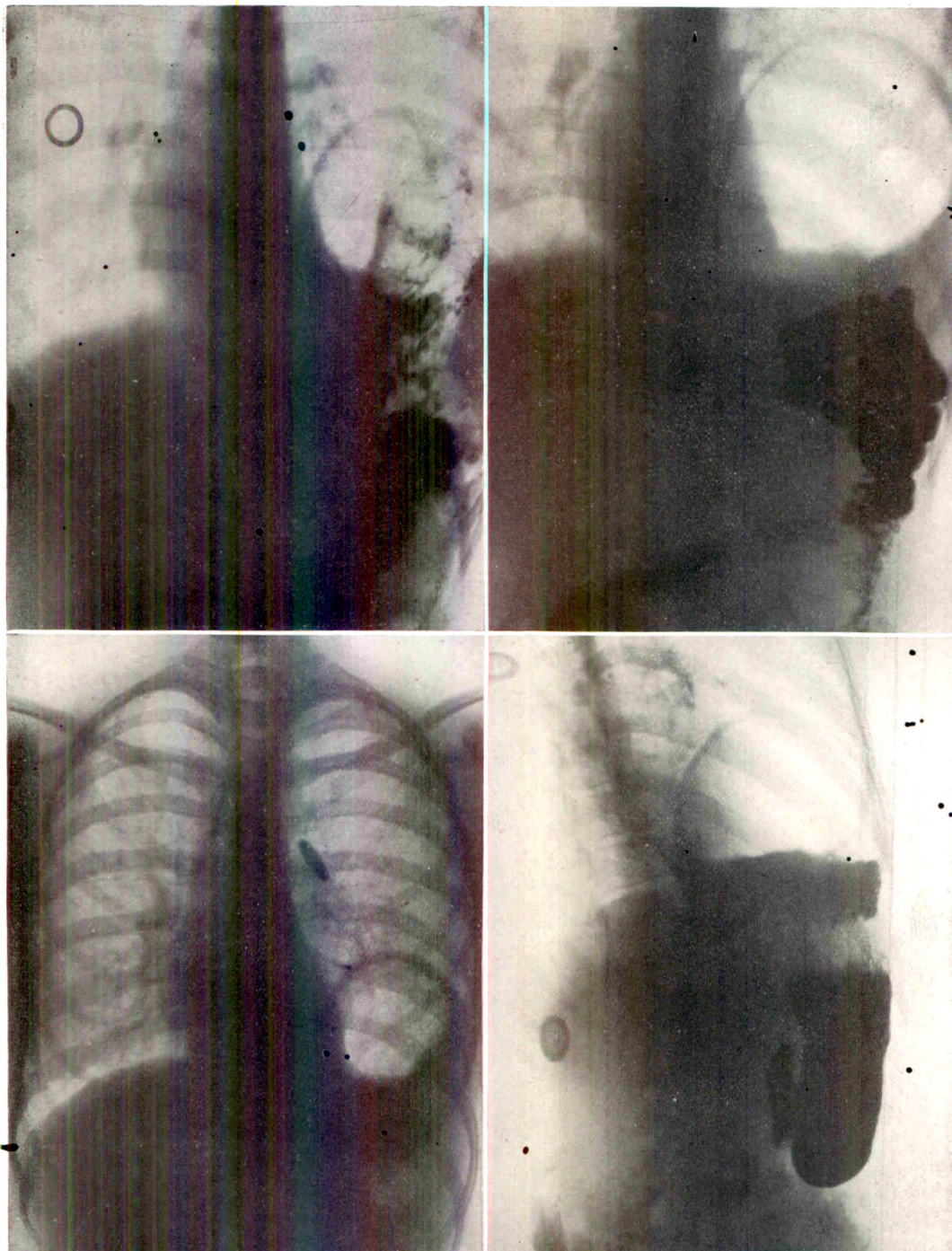
Three years later I took the opportunity of again examining this case—January, 1923. The condition was found to be much the same as at the last examination. She suffers no inconvenience and is engaged in house work.

CASE 2. B. K., male, aged 54. The second case was a man, aged 54, who was operated on for pyloric obstruction. At the operation it was found that the left half of the diaphragm extended high up into the chest, and that the obstruction was due to a torsion of the stomach. This was relieved. I had the opportunity of X-raying this man some months later. The screen examination showed the bow line of the elevated left diaphragm rising up into the chest; the line was continuous across the left hemithorax, but not perfectly regular, as both the air sac of the stomach and the splenic flexure could be distinguished, the different degrees of pressure in the two causing a slight irregularity. Some lung tissue could be seen through the upper part of the dome. The horizontal line of fluid in the stomach was observed, but this extended only part of the way across the left chest. Full, free reversed movements of the diaphragm were noted. Palpation of the abdomen produced waves along the line of fluid. On giving a bismuth meal the stomach was seen to be of the "cup and spill" type. There was no delay in emptying. In the lying down position bismuth food filled up the space under the bow line in the chest occupied by the air sac, and during subsequent examinations the splenic flexure was seen outlined by bismuth. This was evidently a true case of eventration of the diaphragm, in which there were no symptoms until the onset of a pyloric obstruction due to an increased rotation causing a volvulus. At the present time this man is in good health and suffers no discomfort.



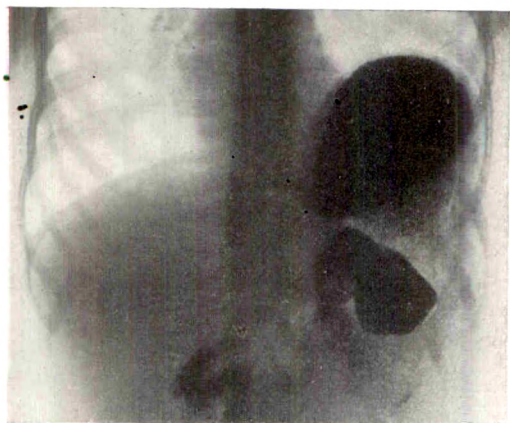
CASE 1.—A. O'B., girl, aged 12 years.

1. Upright position, postero-anterior. Note unbroken bow line in chest, horizontal line of fluid, etc.
2. After bismuth meal, postero-anterior position.
3. After bismuth meal, oblique position.
4. After bismuth meal, supine position.

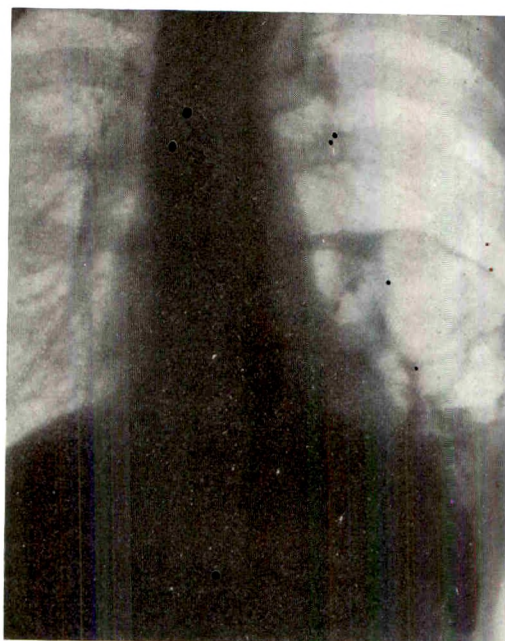


CASE 1.—A. O'B., girl, aged 12 years.

5. Bismuth meal in colon. Upright position. Note flakes of bismuth in splenic flexure, which has risen up under the dome.
6. Splenic flexure filled with bismuth. Note the whole dome is occupied by the air cap of the stomach.
7. The same case three years later after operation. Chest, postero-anterior position.
8. Oblique view after bismuth meal, showing deformity of stomach.



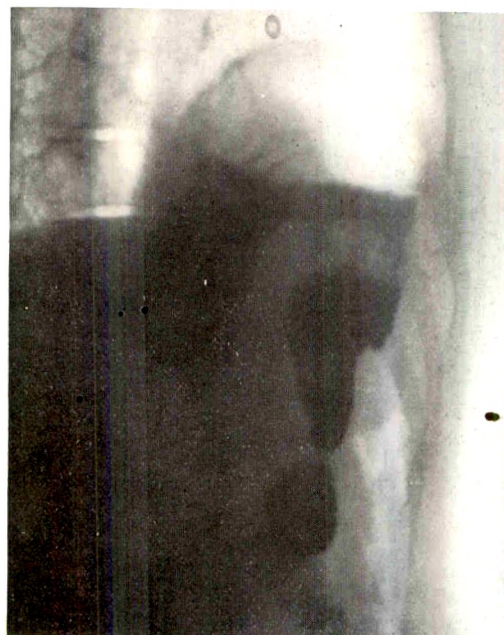
CASE 1. A. O'B., girl, aged 12 years.
9. After bismuth meal, supine position.



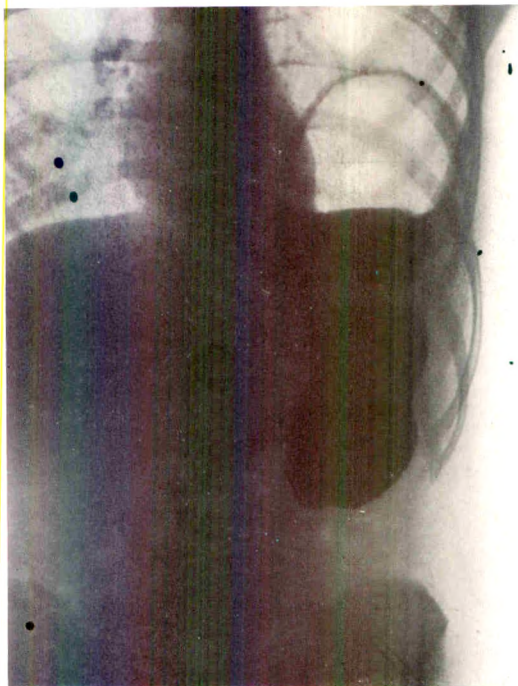
CASE 2.—B. K., male, aged 54 years.
Chest, postero-anterior, upright.



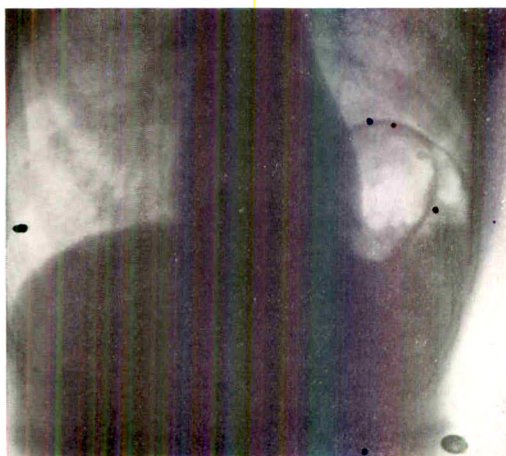
CASE 3.—M. L., female, aged 48 years.
Chest, lateral position.



CASE 4.—H. B., male, aged 41 years.
After bismuth meal, oblique view. Note cup
and spill stomach.



CASE 5.—S. K., male, aged 39 years.
After bismuth meal.



1. Chest, upright postero-anterior position.



2. After bismuth meal, oblique position. Note deformity of stomach.

The third case was a married woman.

CASE 3. Mrs. M. H., aged 48. This case was sent for X-ray examination of the chest. It was noted that the cardiac dullness was displaced to the right, this being the only definite physical sign. She complained of indigestion extending over a period of three years, with occasional sickness and vomiting. There was no acute pain, but often a feeling of discomfort after food.

The X-ray examination showed a regular and typical dome-shaped elevation of the left diaphragm, through which some lung tissue could be seen in the upper part. It rose to the level of the third rib in front. The horizontal line of free fluid in the stomach was present, and the whole of the space beneath the dome at the first examination was occupied by the air sac of the stomach. At other times the splenic flexure was seen to be rising up alongside the stomach under the dome, but it was not always present. There were complete and free reversed movements of the left half of the diaphragm.

On giving a bismuth meal the usual deformity of the stomach was found, although it was not so marked in this case as in some of the others.

She still suffers from indigestion and evidently from an intermittent obstruction, due to drag on the pylorus from mechanical causes.

CASE 4. H. B., male, aged 41. This man was sent to me in December, 1922. For the past twenty years he had suffered from indigestion. The attacks were intermittent, gradually becoming worse. Dr. Fiddian, of Ashton-under-Lyne, his medical attendant, states: "He had, on December 15th, an acute attack of epigastric pain with vomiting. I had great difficulty in getting the bowels moved, and the stool finally was green and offensive. He has been well purged since, starved for forty-eight hours and then fed carefully, but this pain does not wholly disappear; it comes on two hours or so after food and wakes him up in the night."

A bismuth meal was given, and a screen examination revealed a condition similar to those cases already described. The left leaflet of the diaphragm was raised and its movements reversed. It presented an unbroken line stretching across the left hemithorax. Through the dome lung tissue was seen, and it was noted that sometimes the colon rose up alongside the air sac of the stomach under the dome. Once again the typical deformity of the stomach was present.

CASE 5. S. K., male, aged 39. A stone quarry man. He had suffered from stomach symptoms during the past five years. They were of an intermittent character. He had pains two to four hours after food, which were relieved by taking more food. He often suffered from sickness and retching but never vomited. In writing to me Dr. Lynch, of Hayfield, says: "About three months ago I was called to see him during the night. He was suffering acutely, the upper half of his abdomen was very tender. The pain came on very suddenly and steadily grew worse. The clinical picture was suggestive of perforation. As the attack occurred during the night I gave him a hypodermic of morphia, and was quite surprised when I saw him early next morning to find him perfectly well."

Here again I found the characteristic picture already described, the left diaphragm elevated, etc.

CASE 6. J. B., male, aged 51. Labourer. The sixth and last case which I have seen came to the Manchester Royal Infirmary in January of this year—1923. He stated that he was perfectly well until about a month ago, when he developed a bad cold. Suddenly he was seized by a pain in the stomach, was sick but could not vomit. Since then he has had difficulty in swallowing solid food, but no difficulty with liquids. A bismuth meal was taken without much trouble, and it was noted that there was some delay at the cardiac orifice of the stomach; the unbroken bow line of an elevated left diaphragm was seen extending well up into the chest. Its movements were reversed, the typical deformity of the stomach, and all the other radiographic features common to these cases were noted.

From the study of these cases it seems to me that they are much more common than is usually supposed. Most of the cases recorded have been in

adults, and it is due to the advance in radiology that recently more of these cases have been described.

The subject of this condition may go through life without suffering much discomfort, but in my cases it has usually been the gastric symptoms which have called for investigation and led to the radiological diagnosis of eventration.

In Case 2, it was thought that a pyloric obstruction was present; a volvulus of the stomach was found and relieved.

In Case 4, the symptoms suggested a duodenal ulcer; and in Case 5, a duodenal ulcer with perforation.

The subsequent history of these cases, however, is hardly that of an ulcer; at present they are both in good health, as is also Case 6.

In all these cases the diagnosis was based on the elevated diaphragm forming an unbroken bow line in the chest, with reversed movements. These two signs are the cardinal ones; the others, although important, are variable.

(To be continued.)

A LECTURE DELIVERED AT THE CITY OF DUBLIN SKIN AND CANCER HOSPITAL, HUME STREET, DUBLIN, ON DEEP X-RAY THERAPY.

By Dr. PILGER, Erlangen Clinic.

I FEEL much honoured in being invited to speak to you about deep therapy, and I shall endeavour to give you an idea as to how X-ray therapy is practised in Erlangen. The Gynaecological Hospital in Erlangen has developed in late years into one of the largest and best equipped X-ray institutions on the continent, which is due to the energetic and untiring work of its chief, Professor Wintz, whose scientific researches, in connection with those of Professor Seitz, led to the establishment of the Erlangen School, whose researches first brought X-ray therapy out of the chaos of experimental attempt to the basis of a well-founded exact science. Much remains to be done, but we can now say that we have the means by which alone it is possible to progress.

The first aim of the Erlangen School was to get constructed a powerful high voltage apparatus, which materialised in the symmetric apparatus of R. G. S., which gives a constant high tension current over a long time, and this apparatus has proved absolutely reliable during several years' use. The next object was to devise a system for the exact measurement of the quantity and quality of the applied rays. This has been done, with the result that it is now possible to administer predetermined and consistent biological doses of X rays.

I will now briefly explain the physics and dosimetry of X rays.

X rays are waves of the aether-like light, only of much shorter length. Every tube, of whatever construction, produces complex or heterogeneous X rays, i.e., rays of different wave-lengths. When these complex rays enter a body they become more and more absorbed, but the absorption of the long waves (soft rays) is much greater than that of the short waves (hard rays). Accordingly, the soft rays produce only a superficial effect, whereas the hard rays are still

effective in the depth of the tissue. The relative absorption of the rays, moreover, depends upon the atomic weight of the body to which the rays are applied.

For deep X-ray therapy we can only make use of hard rays. The soft rays only affect the surface and are noxious. It is for this reason we use filters, by which soft rays are absorbed and only the harder ones pass through. This filtration, however, is not like a chemical filtration, for it is not a mere separation of hard and soft rays, in so much as the hard rays are also more or less diminished in intensity after the filtration. In Erlangen we have discovered that the best filtration for the symmetric apparatus with Coolidge tube is 0.5 mm. ZN. and 3 mm. Al. The Al. takes away the soft fluoroscopic rays of the relatively high atomic weight ZN., and is therefore placed between ZN. and body. We thus get a radiation that diminishes in direct proportion to the distance of penetration, *i.e.*, in every further cm. the same amount is absorbed, and we call it a practical homogeneous radiation.

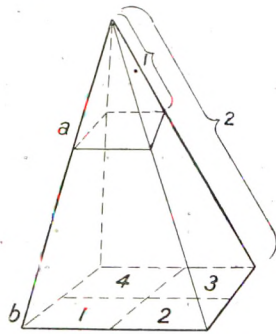


FIG. 1. — Intensity in a ;
intensity in $b = 1^2 : 2^2 = 1 : 4$.

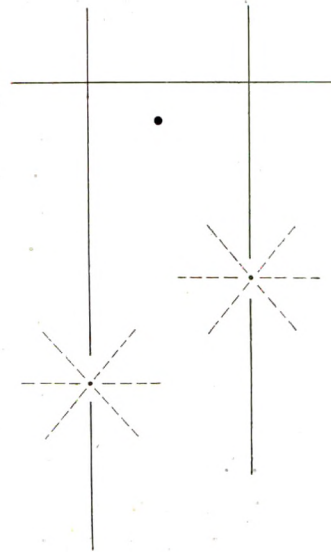


FIG. 2.

We have thus made absorption proportional and homogeneous, but a further loss of X rays has to be taken into consideration, since, according to the law of geometrical divergence, the intensity of the radiation cone is diminished in an inverse ratio to the square of the distance from the focus. (Fig. 1.)

Thirdly, X rays are diminished by disintegration, since a portion of the rays on encountering the atoms of the body through which they penetrate are broken up or scattered in different directions, but this diminution is made up by the quantity of scattered rays which are subsequently produced, and these add so much to the original rays that at certain depths we have a considerable augmentation of the dose. The amount of this augmentation is greater the larger the irradiated cone of tissue and the harder the rays. The reason of this is that the harder rays penetrate deeper and at depth the scattering effect is greater. The scattered rays have the same quality as the original rays. To illustrate that we may compare the effect of disintegration or scattering with the effect produced when light passes through a milk-glass body.

Now we can examine the relation of the dose in the depths to the dose on the surface of the body. Professor Wintz has introduced for this the idea of the *percentage depth dose*. He has calculated the dose at a depth of 10 cm. in proportion to the dose on the surface, which latter is standardised as 100, and he expresses the depth dose in percentages of this. For instance, percentage depth dose 20 per cent. means : Intensity in "A" to intensity in "B."

$$A : B = 100 : 20.$$

According to the physical laws above mentioned, the amount of the percentage depth dose depends on the three factors of dispersion, absorption and scattering, or in other words, on the quality of the rays (influence of absorption and scattering), the size of the field upon the skin (scattered rays come more to effect in big areas), and the distance between the focus and the surface of the body (dispersion).

Now what are the essentials in deep therapy? What is the biological requirement for the therapy of neoplasms? The chief requirement is to give

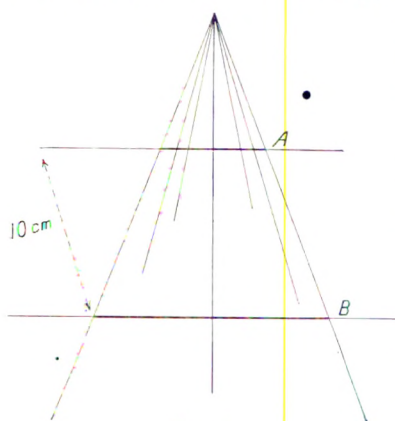


FIG. 3.

the neoplasm itself a destructive dose without hurting the adjacent healthy tissue. That this is possible is chiefly due to the happy circumstance that the cells of the neoplasms or other pathological cells are more susceptible to X rays than the normal tissues, and a dose that causes only a slight irritation to a healthy tissue is capable of destroying tumour cells. Here, as everywhere else, we have the law of Bergognier-Tribondéau and the law of Arndt-Schulz, which lays down that the more unstable the metabolism of a cell (malignant growths, embryonal cells, etc.), the more susceptible to X rays it is. Moreover, every

effect produced, according to the quantity of the rays applied, can be ranged in the three graduations of (1) stimulation, (2) irritation, (3) destruction.

It therefore can happen, when we have sound and malignant tissues adjacent to one another, that the same quantity of X rays may produce a destructive effect on the pathological cells and at the same time have the effect of irritating or of stimulating the normal tissue. To obtain a more exact solution of this problem it was necessary to ascertain with precise exactitude the quantity of X rays just sufficient to destroy a tumour without being in excess of what the normal tissue and the skin can bear.

These measurements of X rays are based on the ionising effect of X rays in the air. Whenever X rays pass through the air, the molecules of the air are ionised and it becomes a conductor for the current. It has been found that the ionising effect is proportional to the intensity of X rays absorbed in the air, and practically proportional to the absorption in the body and the biological effect produced there.

The instrument used for this purpose is the *iontoquantimeter* invented by Scillard, improved by Professor Wintz and constructed by R. G. S.

The arrangement is best described by this diagram. By the ionising effect of the X rays in the chamber "T" the electrometer is discharged to the earth, and the time that elapses during the rate of discharge, measured on a fixed scale, is proportional to the quantity of X rays. We thus measure the quantity of X rays absorbed and therefore effective by measuring the time of discharge. The shorter the time the greater the intensity.

To measure the quality of X rays we measure the percentage depth dose. For if the condition of the absorbing material (body), size of field and focal distance are the same, the percentage depth dose is an exact measurement of the quality of X rays. The measurement of the percentage depth dose is made by means of the water phantom or a wax-block. We measure the rate of

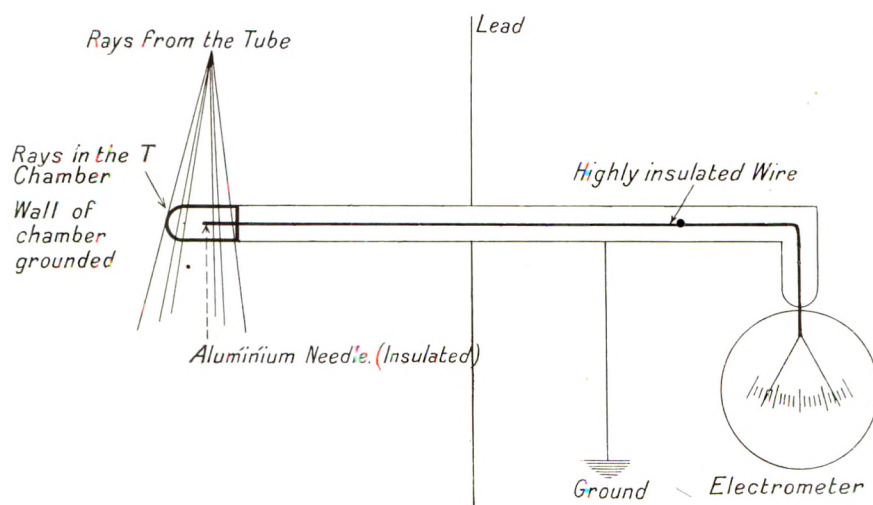


FIG. 4.—Electricity flowing from the Al. needle through the ionised air to the wall of the chamber.

discharge on the surface of this and then below it in 10 cm. depth, and the times are in inverse proportion to the doses.

In order to have the same conditions as in the body, we must also place a block beneath the ionisation chamber in order to reproduce the scattering effect of the deeper tissues, which is not inconsiderable.

By means of this instrument it has become possible to regulate the apparatus and the tube so that they may always produce a constant quality and quantity of X rays. Certain measurements on the patient's body are next required, and Professor Wintz determined a fixed biological unit dose—the so-called unit skin dose or erythema dose, i.e., a dose that produces, eight days after irradiation, a slight reddening, and after four weeks a tender but well visible brown.

It was found that this dose could be fixed within a limit of ten to fifteen per cent. This dose, as fixed by a certain number of minutes exposure with a certain apparatus running under certain conditions and a certain tube, was standardised as 100. It produces discharge of the iontoquantimeter in a certain number of seconds. Whenever we had a discharge of the iontoquantimeter

in this certain number of seconds we had the unit skin dose. When, for instance, with another tube the rate of discharge took less time, the unit skin dose time was in the same proportion shorter. Thus, we had a calibration of the iontoquantimeter in relation to the biological effect, and we could determine in advance the biological effect of other tubes by means of this iontoquantimeter. The first tube was taken as a standard tube and carefully preserved, and by it, it is possible to control in return the iontoquantimeter. But it is safer always to control the biological effect (on skin).

The unit skin dose being standardised as 100 per cent., it was ascertained, for instance, that the cancer destructive dose was about 90 to 110 per cent., the sarcoma dose 70 to 80 per cent., the sterilisation dose 35 per cent., and so on.

Now I can explain how the Erlangen technique developed from the above deductions. Let us first take the problem of sterilisation. There are various gynaecological diseases, mainly at the age of about forty, that are based on loss of function of the ovaries and cause morbid changes and other disturbances. It has also been found that uterine myomas are in correlation to the ovaries, and that they shrink when the function of the ovaries is eliminated. All these diseases are indications to suppress the function of the ovaries by sterilisation. As I have told you, the sterilisation dose has been found to be 35 per cent. at the ovaries. With our apparatus in use (symmetric and Coolidge), and when we use our focal distance of 23 cm. and field size of 6 cm. by 8 cm. we get about 18 per cent. at a depth of 10 cm. (thin patient), when we have 100 per cent. at the skin. The ovaries lie at about a depth of 10 cm. When we give to each ovary two fields, the one in front and the other behind, we have the sterilisation dose. In fat patients a greater field size is used (8 cm. by 8 cm., 10 cm. by 10 cm.). In general it is safer to use 8 cm. by 8 cm. After four to six weeks the ovarian function ceases and the morbid changes are over. We thus effect by X rays in a short time what nature does in a long time, and sometimes in a less satisfactory way.

Let us now regard the problems of uterine cancer. The uterus lies centrally in the pelvis, and, as a rule, its depth can be estimated at 10 cm. With one of our concentrating fields we can give 18 per cent. at the uterus. We therefore want 6-7 fields to get the cancer dose, and we do so by giving three fields in front and three from behind, and in the case of a fleshy patient one from the vulva. In thin patients five fields may be sufficient.

For each field we want about half an hour. By this amount of exposure we are only able to concentrate the X rays upon the primary tumour, but we find very often that the glands of the pelvis and the parametrium are soon infiltrated with cancer cells. In order to make the irradiation effective we must give every cancer cell its dose. Accordingly, after a period of from six to seven weeks after the primary radiation, in Erlangen both the parametria are radiated (see Fig. 5).

This second radiation is absolutely necessary, for if you do not give it the scattered rays from the first radiation have a stimulating effect upon the more remote cells of the parametrium.

The main difficulty of this cross-fire method lies in the concentration. It is like shooting an invisible target. Moreover, if you do not concentrate accurately you may cause injuries in sound tissues by over-dosage; moreover, if several radiation cones concentrate at a wrong point you may give a stimulating dose to the cancer cells.

For those cases of cancer which are centrally situated the cross-fire method is good, but new difficulties arise when we have cancer of more irregular extension and eccentric situation, which makes it impossible to concentrate from every side, as for instance in the case of cancer of the breast or skin. In such case the only alternative is to give the dose all over the cancer, in one or two fields, which can only be done by augmenting the percentage depth dose. As before mentioned, the percentage depth dose depends upon three factors—absorption, dispersion and scattering. The loss from absorption can be reduced by using the hardest rays possible (high voltage, filter). With our modern apparatus and filtration we gain already a radiation that cannot be much improved in quality by more voltage and filtration. Secondly, we can

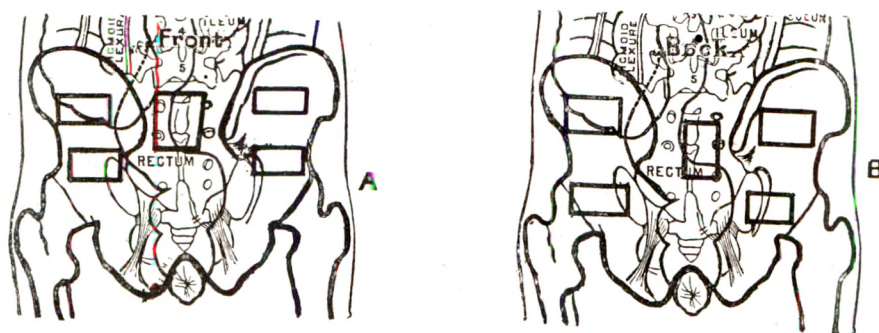


FIG. 5.

make dispersion as small as possible by augmenting the focal distance, but the gain is only possible by sacrificing time. The time of exposure increases with the square of the distance, and thus gain is also limited; nevertheless, a quite considerable gain can be effected. Thirdly, we can augment the amount of the dose at a depth by enlarging the cone of irradiation, i.e., by enlarging the field size. This is due to the influence of scattered rays, which are formed when the primary rays meet the atoms of the tissue. It comes to this, that we can improve the percentage depth dose by augmenting both field size and focal distance. If, for instance, the cancer lies at a depth of from 1 to 3 cm. beneath the surface, with a field of 6 cm. by 8 cm. and a distance of 23 cm., we could get a dose of 53 per cent. at the third centimetre. At 70 cm. distance we would get 65 per cent., and by enlarging the field to 10, multiplied by 15 cm., we would get about 75 per cent. A further 10 per cent. to be applied from another side would be sufficient to get a minimum cancer dose at the third centimetre. Accordingly, we radiate cancer of the breast by two fields, one in front and another from behind. The distance and field size depend on the situation and size of the tumour. The supraclavicular and axillary glands must also, of course, be radiated. As we always calculate

the cancer dose at the lowest limit, we generally give in these cases a second radiation.

In the case of cancer of the vulva, for instance, a distance field of one metre is used, and additional doses to the inguinal glands and glands in the small pelvis are given.

It would take too long to describe to you all the different modifications that are necessary for the various kinds of cancer and other neoplasms. It would require a separate lecture. Moreover, it would not be possible to prescribe strict rules for invariable observance, since every case must be treated individually, with due regard to the above-mentioned principles. I shall therefore touch upon the most important points. You understand that there are two methods of giving the cancer dose to a tumour—the concentrating or cross-fire method and the distant-field method. Sometimes we can employ both of these methods. For instance, in uterine cancer we can either apply the dose by four distant fields—from in front, from behind, and from both sides, or by only two fields—from in front and from behind and radium in the cervix.

Perhaps you may now ask why it is that we do not always use the distant-field method, which is comparatively simple, whereas the cross-fire method is more difficult and dangerous and requires the exercise of much skill. The reason is the general harm and noxious influence that may be caused to the body by large X-ray doses. The effect of these is chiefly manifested in the blood circulation. Immediately after irradiation we have a sudden fall of lymphocytes and a relative leucocytosis.

In using distant fields we radiate much larger areas of the body, and the radiation cone is so great that the damage done to the blood requires six to eight weeks to be overcome, while with the concentrating method we can say that in about three weeks the blood has recovered. When we can avoid damage by false concentration this method seems to be the most advisable. Therefore, whenever possible, in Erlangen large cones of irradiation are avoided and concentrating tubes are used. To my mind one should make the best out of each method. From this point of view, the combined method as I have seen in Frankfort (Professor Seitz) is very obvious. In uterine cancer, for instance, the primary growth is at first treated by concentration. After six to eight weeks the parametria are treated by distant fields. To facilitate the difficult choice in the form of application, Professor Holfelder, of Frankfort, has constructed an ingenious apparatus, "the field selector," by means of which the dose and distribution of rays can be observed on an illuminated showcase.

The intention of safeguarding the body leads me to another problem. What I have told you up to now in brief terms consisted of rules and instructions for the purpose of giving the required dose of X rays to a neoplasm or a pathological organ. But that is not sufficient, to apply a dose to a cancer and to do nothing more. To obtain good results it is also necessary that the destroyed cancer should be replaced by new healthy connective tissue, which

growing up from the environs of the damaged cancer will give the latter its final knock-out. This is only possible when the body is capable of providing the necessary forces. It is our main task, therefore, to help the body in this work. There is no doubt that in all the radiated parts of the surrounding tissue there is an inflammatory reaction which, under certain circumstances, we can consider as a stimulation to the formation of connective tissue. The danger of overdosage lies chiefly in the fact that an injured tissue is no longer able to create the tumour-killing forces. The same negative effects can be seen when the constitution of the patient is weakened by cachexia, or if some vital organ (intestines, stomach glands) is injured by overdosage and so prevents the body from recovering from the after effects of radiation. These conditions manifest themselves in the blood.

We regard it, therefore, as a matter of great importance firstly to create the best conditions for radiation by adequate preparation of the patient. The biological effect of the X rays is chiefly attributed to the transformation of their absorbed portion into the so-called secondary rays—scattered rays, fluoroscopic and *beta rays*. These latter are nothing else than electrons (like the cathode rays), and it is they that are instrumental in producing the biological effects. We must therefore take care that the formation of secondary rays in the healthy tissue is reduced as much as possible. Before radiation the bowels should be emptied by enema, and likewise the bladder. It is especially necessary to see that there are no remains of a barium contents in the bowels, as elements of high atomic weight such as barium produce much more *beta rays* than others. We must take care that every metallic producer of secondary rays in the healthy tissues is eliminated. We should not, therefore, give the patient before radiation medicaments that contain iron or any other metal.

The use of the compressing applicator is recommended when the cross-fire method is adopted. By compression we first produce anaemia of the skin, thus making it slightly less susceptible to X-rays. Secondly, the movable bowels are pressed aside by it, so that they do not interfere so much with the cone of radiation.

It is necessary to examine the blood before and after treatment to see the changes that take place. Usually, after having given a large dose, we find diminution of the lymphocytes and at the same time a relative leucocytosis, changes in the time of coagulation of blood, at first diminished and then increased, and changes in the number of eosinophiles, and finally, slight diminution of the red corpuscles. If the condition of the patient before treatment is good, it has been found that he recovers fully after three or four weeks, if the after treatment is correct. In the after treatment our main task is to avoid all irritation to the radiated part of the body. All radiated tissue has more or less lost for some time its power of resistance against irritation, and is to be regarded as a *locus minoris resistentiae*. To ensure a good recovery of the skin we use only a thoroughly indifferent unguentum (*unguent leniens molle*), which is applied twice every day for some weeks. In

gynaecological radiation we make rectal injections of pure olive oil to protect the mucous membrane of the rectum. All sorts of irritation must be avoided. It is necessary to give the patients distinct instructions on these points, and in Erlangen they are supplied with these in print.

Besides these local precautionary measures we must also direct our attention to the improvement of the general condition of the body. The general effect of radiation of the body is at first a transient X-ray sickness or indisposition immediately after radiation, accompanied by vomiting and headache. It is of no particular significance and the patient quickly recovers from it. There is also mostly a remarkable and pronounced feeling of thirst. It is clear that by large doses of X-ray the chemical composition of the blood must be altered. As I have already told you, the X rays throw out electrons from the atoms—the so-called secondary beta rays. By this chemical reactions are initiated and the osmotic tension of the solutions in the blood is changed. Perhaps this may account for the feeling of thirst. Accordingly, immediately after radiation in Erlangen each patient get a subcutaneous injection of physiological NaCl. solution. In all cases the patient after treatment should remain in bed for some days, or even weeks, in order that the patient might be able the more quickly to recuperate from the permanent changes wrought by the X rays. Rest, good and light diet (vegetables preferable) are essential after treatment in the abdominal region. The stimulation of the latent forces in the protoplasm of the cells by means of intravenous injections of sterilised albuminous preparations (f.l. albusol) (protoplasm stimulation) is beneficial in after treatment, as also treatment by iron and arsenic.

Taking into consideration these briefly sketched principles, good results can be obtained in all kinds of malignant growths. In whatever way the question will be subsequently decided, as to whether operable cancers should be treated only by X rays or should be operated and only prophylactically treated by X rays, there is in any case no doubt that there has been made a great advance in the fight against this terrible enemy of mankind. Too short a time has elapsed to say whether this new branch of therapy will in time entirely replace surgery, but the results so far obtained in cases of malignant growths are at least as good as those of surgery. We must also take into consideration the fact that in compiling statistics the surgeon only takes operable cases into consideration and excludes inoperable ones, whilst X-ray therapy statistics include a large number of inoperable cases in which X-ray treatment is the only possible one. The fact that a certain percentage of inoperable cases of malignant growths can be cured by X rays has made deep therapy a problem that no thinking doctor of eminence in the profession can overlook. Sarcomas are specially suitable for X-ray treatment, and no more amputations should be made because of sarcoma. Still better are the results in lympho-sarcoma and lympho-granuloma (Hodgkin's). In the treatment of myomas and climacteric diseases, the results obtained are so excellent, the treatment is so safe and painless, that it is beyond discussion. Operation in the case of myomas should no longer be performed, unless they affect the

region of the bladder and subsequently cause further complications, and unless there are necrotic and infectious parts in it, or unless the tumour be so large that it threatens the function of the bladder or rectum.

In the last few years, in the Gynaecological Hospital in Erlangen, there has been introduced by Professor Wintz a means of treating chronic inflammatory tumours of the adnexes. These processes are very lengthy, and the tubes and the ovaries resist all kinds of treatment. They are subject to recurrence by reason of the monthly congestions that take place in the female genital organs.

By suppressing the function of the ovaries for two to three years by a suitable dose of X rays to the ovaries (a little smaller than the full castration dose), excellent results in these diseases have been obtained. In short, other diseases which can be successfully treated by X rays are tubercular glands, tuberculosis of the peritoneum, tuberculosis of the joints, especially of small joints.

It would take too long to enumerate all the skin diseases that can be successfully treated by X rays, but in general it has been found that also here the use of hard penetrating rays give better results than the use of soft rays.

Excellent results have been obtained in advanced cases of actinomycosis. Other suitable cases for treatment are glands of internal secretion, either in order to suppress the high hyper-function or to stimulate a hyper-function. Here the possibilities of exact dosage, as it is now possible, promise a great new therapeutic area. In the treatment of Basedow's disease, for instance, two-thirds of U.S. dose to the thyroids and the thymus give excellent results as regards almost all the typical symptoms.

This short view shows that X rays have conquered a dominant position in therapy, and that in consequence of the exactitude of application that is now possible. The time of arbitrary treatment, just as experimenting with a medicament whose quality and quantity one could not ascertain, are over.

DR. SEEMANN'S X-RAY SPECTROGRAPH.

WHEREAS the problem of X-ray dosage has been to some extent solved by the discovery and perfecting of the dosimeter with the ionisation chamber, the knowledge of the qualitative combination of the rays applied with or without filter still leaves much to be desired. Until recently, it was impossible to obtain anything like an exact and reliable measurement of the hardness of the whole of the components contained in a filtered or unfiltered irradiation and of their relative reciprocal intensity. But until every X-ray expert knows the degree of hardness possessed by the irradiation components used by him, or can physically express what wave-length interval surrounds the spectrum of the irradiation, no uniform and complete reply can be given to the burning question, whether the biological effect of X rays of different hardnesses is

exactly the same with a similar dose and similar total intensity. And especially whether the hardest components producible at the present time exercise a specifically favourable action on certain manifestations of a disease.

In the Krönig memorial volume of *Strahlentherapie*, X, pp. 1064-1110, 1920, Küpferle and Seemann, in 1920, proved by practical demonstration the extraordinary and comprehensive value of X-ray spectroscopy for X-ray treatment as well as for diagnostic purposes. But it is only to-day that a model of an X-ray spectrograph can be placed on the market which fulfils the requirements with regard to simplicity in manipulation and certainty of result.

It is due to the unrecorded works of Seemann, since 1914, that this result is attained.* He at once recognised that Bragg's old method was not appropriate for the hard rays, because it would give a fundamentally blunt, and therefore faulty, spectrum of them. He succeeded in evolving a new spectroscopic method in 1917, in which he completely mastered the disturbing phenomena formed by the elements grouped around the spectrograph. He called it the Camera Perforation Method.

GENERAL DESCRIPTION OF THE SPECTROSCOPE.

This is the principle on which treatment with the spectrograph is carried out, as is indicated in Figs. 1 and 2. A and B form the camera, which is turned backwards and forwards around the axis D by the clockwork situated at C. The rock crystal, about 8 cm. in length, which serves as an analysator, is enclosed hermetically at E. Only very perfect pieces of this material, which in itself is not rare, with very few splits, serve for the requirements necessary for the production of an exact spectrum through almost mathematically exact localisation of their atomic strata. Other crystals cannot be considered at all, owing to their distinctly slighter reflection capacity, or because the spectra they provide are too small, as, for example, calcareous spar, gypsum, mica, quartz, sugar.

As the applicability of the pieces of rock crystal can only be discovered by testing them in the spectrograph, and only by means of its radiation, which should analyse them, the few pieces found in a large stock are of great value, far exceeding that of the rest of the apparatus under consideration.

Fig. 1 shows schematically how to set up the spectrograph and to point directly to the combustion spot by means of the sight apparatus Vv and Ww. Not only with this adjustment, but also when the exposures are being made, the tubes may with advantage be placed in their protection box on the stand. The head E may be brought immediately up to the wall of the tubes, if not working at extreme high tension. The box H in its driving slit is shown in Fig. 2.

APPLICATION OF THE SPECTROGRAPH.

As in optics and optical technique, only the photographic fixation of a spectrum, a spectrogram, can give a clear picture of documentary value of the

* H. Seemann. *Physikal. Zeitschr.* XV, pp. 794-797, 1914; XVIII, pp. 242-249, 1917. *Annalen der Physik.* XLIX, pp. 470-480, 1918; LI, pp. 391-412, 1917; LIII, pp. 461-491, 1918.

quality of the rays and the relative quantity of the radiation components. The subjective observation of an X-ray spectrum does not come into consideration for exact spectroscopy, for reasons to be found in the peculiarity of the production of the X-ray spectrum.

With the Seemann spectrograph one is enabled to read off the length of the waves (degree of hardness) on a scale with the naked eye, without any calculating manipulation (see Fig. 4). The medical man, therefore, who is performing the spectroscopy with the aid of the apparatus, can immediately give the number of components contained in the more or less filtered radiation used by him, and above all, which of them are the hardest.

This boundary component or boundary length of wave is the one sure measurement for the working voltage of the tubes. The determination of the length of their waves enables one to obtain complete control of the current conduction of the instruments given by the manufacturer. Moreover, it is possible to estimate adequately with the naked eye the intensity (quantity) of the hardest components in comparison with the softest, in order to arrive at a conclusion with regard to the constancy of the working of the voltage during each individual current impulse, or respectively over the more or less near approach to the ideal working condition with high tension direct current.

Particularly simple and ingenious contrivances, so-called bisecting diaphragms (Fig. 2, G and F), make it possible to bring side by side two different spectra on the same plate, so that they can immediately be compared with each other. If, for example, one has to do with the rays generated by two different tubes with the same working current, or to compare the same tubes with different working currents, or with different instruments, then one following the other, one exposure of each would be made on the same plate, without the box H being drawn out or changed. Only the bisecting diaphragm in front of the box is turned round.

In a similar way, with the help of the diaphragm G, the action of two different filters can be examined on one and the same spectrum, but with only one exposure. There is also space in the camera for very thick filters, for example of fluids and powders, so that the factors of dispersion of such light materials can also be examined for the different component parts.

The spectrograph is not only suitable for measuring the rays necessary for treatment, its measuring capacity also embraces the harder half of the spectrum of diagnostic irradiation, which part plays an important, most disturbing rôle in the irradiation of thicker portions of the body.

The box H can be filled with plates or films with or without intensifying screens. A comparison of the intensifying action of two different screens can be undertaken similarly as with the filters, so that the difference of the intensity of the different irradiation components can be made visible side by side on the same photographic plate with a single exposure.

The exposure times, which with the old Bragg spectrographs required many hours, indeed days, are now reduced to minutes. When working with tubes with 2 milliamperes and 160 kilovolts, with intensifying screen, they require

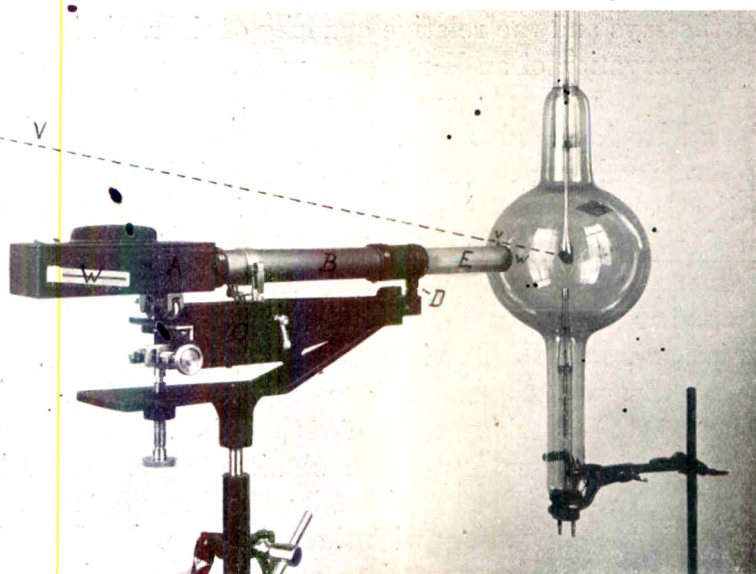


FIG. 1.



FIG. 2.

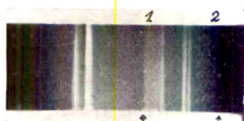


FIG. 3.

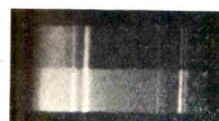


FIG. 4.

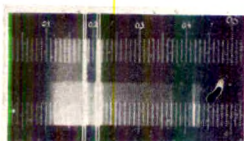


FIG. 5.

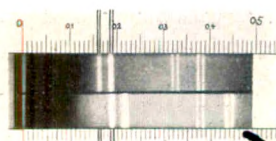


FIG. 6.

20 minutes; with 8 milliamperes the corresponding time is 5 minutes, without intensifying screen 60 and 15 minutes respectively. This only applies, however, to specially sensitive X-ray plates, especially as regards the times given for exposures without intensifying screen. Doubly fused plates or Schleussner's new neo-plates are specially recommended, if they can be developed for a long time with glycerine developer.

SPECIMEN SPECTROGRAPH.

Fig. 3 shows a typical unfiltered spectrum exposure, which was taken without intensifying screen. The clear lines on the left are the representations of the spontaneous radiation of the anticathode metal. The group of lines on the right are those of the second disposition (repetitions). The grey ribbon-like underground of the lines is the continuous X-ray spectrum, in which at 1 a weak deposit is recognisable parallel to the lines. It comes from the barium holder of the tube glass. It is the so-called barium absorption boundary. A similar edge is visible at 2, but reversed with its darker side directed towards the right. It is the silver absorption edge of the bromide of silver of the photographic stratum.

Fig. 4 represents a spectrum of a Coolidge tube, taken with two filters side by side and one above the other respectively. At the upper horizontal half of the 1.2 mm. thick copper filter, only the region of the continuous spectrum left of the two Wolfram spectral lines has remained over, while that of the under half of the plate covered with a 1.2 mm. thick copper filter, only a considerable part of the spectrum to the right of the two lines has remained over. The last radiation contains, therefore, considerably more weaker components.

Fig. 5 shows the same exposure with scale copied on to it, on which the two sharp double lines are indicated at the spectral place of the Wolfram spectral lines, to serve as cover marks with the spectral lines of the spectrum and so guarantee the correct position of the scale on the spectrograph. It can be seen at once that the hardest component of the continuous spectrum lies at about 0.11 Angström units, the weakest components of the lower spectrum about at 0.35 Å. From the first-mentioned number it is possible to calculate for all cases the maximum voltage (peak voltage) which is at the moment on the tube. This is done by dividing in all cases into the same number, namely, 12,300, for instance, $12,300 \div 0.11 = 111,818$ volts, or approximately 112 kilovolts.

Fig. 6 gives again two different spectra taken one after the other. The upper half starts from a tube with tantalum-anticathode, the lower from a platinum anticathode. The different positions of the spectral line of the tantalum and the platinum respectively, i.e., the different lengths of the waves, is characteristic of these metals. Although both tubes are worked with exactly similarly constructed transformers and the same working current, the spectra show very marked differences, not only in hardness, but also in intensity in favour of the tantalum, a fact hitherto unexplained, but very important from the technical point of view.

It must be noticed that in all exposures reproduced here the delicacy of the originals is naturally lost. This applies above all to the recognition of the hardest components and to the edges of the absorption band. Thus, for example, on the original plate of Figs. 4 and 5 it is clearly visible that the hardest components lie between 0.09 and 0.1 Å. The working current, therefore, was actually over 130 kilovolts.

For the scientific measurement of the intensifying distribution of the individual components, a simple estimation of the blackness of the different spectral regions with the naked eye no longer suffices. Accurate examinations of this description must be undertaken with the help of a microphotometer, or better still, be carried out by experts at a physical institute.

SEVENTEENTH FRENCH CONGRESS OF MEDICINE.

The Seventeenth French Congress of Medicine will be held at Bordeaux from the 27th to the 29th of September, 1923.

NOTES AND ABSTRACTS.

Results of the Treatment of Climateric Hæmorrhages by Radium Therapy in the Radium Clinic, Stockholm.—JAMES HEYMAN, Stockholm (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 470-474).—From 1916 to 1921 there have been forty-nine cases of non-complicated climateric hæmorrhages treated at the Radium Institute in Stockholm, Sweden. These cases were subsequently followed. All of them were treated by radium. A single treatment in forty-one cases, of which thirty were intrauterine and eleven vaginal; in seven cases two treatments, and in one case three treatments.

Result: Amenorrhœa in thirty-two cases, oligomenorrhœa in sixteen cases. One case was unsuccessful.

On the Question of the Distribution of Intensity of the Gamma Rays of Radio-active Substances within an Absorbing Medium.—OTTO A. GLASSER, Frankfurt a. Main (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 475-479).—The cause of the difference between the measured and the estimated dosage values of different researchers is explained. Emphasis

is laid on the presence of a considerable additional dose of scattered radiation in the absorbing medium by the hard gamma radiation, and the importance of proving this by a faultless method of measurement. Mention is once again made of the peculiar shape of the surfaces of equal intensity (isodoses) as important for practical use, and it is suggested that a uniform term should be adopted for these surfaces.

On a Device for the Diaphragming of the Secondary Radiation during Roentgen Diagnosis.—ÅKE ÅKERLUND, Stockholm (*Acta Radiologica*, Vol. I, Fasc. 4, pp. 480-486).—After an account of the various contrivances designed by Bucky, Lotzin and Potter for the diaphragming of the secondary rays in the roentgen diagnosis, the author describes a new model of a movable secondary diaphragm which has yielded extremely promising results. This diaphragm has the shape of a rotating, flat, circular plate of transparent material, on which a number of close-set, spiral leaden strips are applied parallel to each other and centred exactly in the centre of movement,

and which are at the same time adjusted in the plane of the primary ray, so that they converge towards the tube focus.

Treatment of Uterine Myomata.—J. RÉCAMIER (*La Gynécologie*, December, 1922, p. 714) surveys the treatment of uterine myomata during the last fifty years, and discusses the present-day indications for surgical, X-ray, and radium treatment. Radium or X-ray therapy in expert hands is without danger and usually efficacious in cases of uncomplicated myoma, but has the drawbacks that (1) the curative action is obtained as the result, and at the price, of a sterilisation of the ovaries; (2) not all myomata can be diagnosed in the unopened abdomen, and to irradiate a supposed myoma, which is in reality an ovarian cystoma or an inflammatory adnexal condition, may cause grave and even fatal complications. Surgical treatment, which permits of exact diagnosis and of carefully planned conservative measures with regard to the genital functions, is nevertheless fraught with a mortality of approximately 6 per cent. (hysterectomy) or 8 per cent. (myomectomy). In assigning the various classes of myomata to radiological or to operative treatment, Récamier lays down the following general rules: Radiotherapy is called for, provided the diagnosis be not doubtful, in small or medium-sized tumours, in the diffusely fibromatous bleeding uteri of the menopause, and in patients whose general condition of health contraindicates surgical operation. Myomata unsuitable for radiotherapeutic measures are those which are large, high and subperitoneal, low and intraligamentary, degenerated, suppurating, submucous, and enucleable *per vaginam*; also those requiring intervention during pregnancy. According to the author, about one-third of myomata require operation; two-thirds may be left to X-ray or radium treatment. He believes that subtotal hysterectomy (the mucosa of the cervical stump being excised) is the operation of choice in the majority of women over forty years of age having subperitoneal or interstitial myomata. Myomectomy is most suitable for women who are not yet thirty-five, having myomata which are few and subserous, and possessing healthy adnexa; even in a young woman, however, it is better to do subtotal hysterectomy than to

leave a "loque utérine" after multiple myomectomy.

Radium Treatments of Keloids.—E. M. DALAND (*Surg. Gynec. and Obst.*, January, 1923, p. 63).—Daland reports forty-eight cases of keloid created by radium. Ten of the forty-eight cases are still under treatment. Of the others, twenty-six have had a complete destruction of their lesions. Three patients ceased treatment before a sufficient number of applications had been made. Two patients developed new keloids near the old ones. Every case treated was benefited. The first evidence of relief was the development of a certain amount of anaesthesia in the lesion. Later there was a disappearance of the itching sensation. Finally, there was a softening of the scar.

Daland thinks that it is probable that every keloid can be destroyed by radium if a sufficient dose is used. He considers that silver filtration (1 millimeter) should be used in keloids of recent origin, in children, in people of dark complexion, and in exposed areas such as the face. The dosage should be from 30 to 60 millicurie hours, according to the age of the patients.

Practically unfiltered tubes should be used on all other keloids. The dosage should be from 15 to 30 millicurie hours per tube. It should be explained to the patient that ulceration will result from this type of treatment.

There is no evidence to show that the destructive doses damage the tissues so that the lesions recur. There is no lessening of the tendency of an individual to develop keloids.
C. P. G. W.

Diverticula of the Bladder in Children.—A. HYMAN (*Surg. Gynec. and Obst.*, January, 1923, p. 27).—Hyman reports three interesting cases of diverticula of the bladder in children, and he is of the opinion that undoubtedly there will be an increase in the number of cases reported as soon as cystoscopy in children becomes more of a routine procedure.

Vesical diverticula are rare findings in children, not more than thirty being found in a review of over 600 cases.

Diagnosis of this condition in children should present no difficulties. Little value should be placed on the history. Physical

examination of the abdomen is of considerable importance. A chronically distended bladder, especially if asymmetrical in outline, should make one suspicious of a diverticulum. The cystoscope and a skiagram taken after filling the bladder with an opaque fluid are absolutely essential in making a correct diagnosis. Of the two, the skiagram will be found more valuable.

No evidence of obstruction, either vesical or urethral, were found in the three cases reported by Hyman. All three diverticula were in immediate proximity to the ureter; in one, the ureter opened into the sac, and as a result the ureters were compressed to such a degree as to cause obliteration of the lumen, with resultant dilatation. Division of the ureter with reimplantation was performed in all three cases, with recovery in each case.

C. P. G. W.

Cystography in Prostatism.—PIRONDINI (*Riv. Osped.*, January 15th, 1923, p. 1) directs attention to the diagnostic value of cystography in prostatic cases. The bladder is filled with a 2 to 5 per cent. solution of potassium iodide or 5 to 15 per cent. solution of sodium bromide, and the X-ray tube directed strictly vertically. Three points are to be noted: (1) the generic form of the vesical shadow; (2) the small irregularities of the margin of the shadow; (3) the lower edge of the shadow is above the pubic symphysis line. Of these three facts the third is the most important. Whenever this lower line is above the pubic line it is safe to say that prostatic adenoma exists. The cause of the elevation is the raising of the floor of the bladder. Some prostatic adenomata of periurethral localisation do not raise the base of the bladder, and in such cases this clear interstice is not present, and other means of diagnosis may be necessary—for example, cystoscopy. Cystography is particularly useful when the passing of an endoscope is difficult or dangerous, and when there is great vesical irritability or severe hæmaturia. Several cystograms are given, which illustrate the author's statements.

(B.M.J.)

X-ray and Radium Treatment of Enlarged Tonsils.—T. NOGIER (*Paris méd.*, February 3rd, 1923, p. 109) states that X-ray treatment of enlarged tonsils was first introduced by Regaud and himself in 1913, and has since been

used by Cécikas of Athens in 1919, and later by Murphy, Witherbee, and others. Some forms of enlargement of the tonsils are more suitable than others for this method of treatment. Moure distinguishes two forms of tonsillar hypertrophy—true hypertrophy and lacunar hypertrophy. In the former all the anatomical elements of the tonsil are more or less enlarged, while in the latter the crypts and follicles become distended by the products of secretion and give rise to a pseudo-hypertrophy. In true hypertrophy the soft form is most frequent in children and the hard form most frequent in adults. The best results from X-ray treatment are obtained in the soft form, both in the child and the adolescent. In the lacunar form the treatment produces only slight improvement. In the hard forms of hypertrophy the benefit obtained by X-ray treatment is very slight, owing to the abundance of sclerotic tissue. In suitable cases the immediate results are manifested about a fortnight after the first sitting, and consist in a marked and progressive diminution in size of the tonsils, and a change in their colour from bright red to a pale pink, while the surface, which was previously granular, becomes smooth. The functional symptoms also diminish in intensity; the respiration improves, snoring in sleep ceases, phonation becomes more distinct, pain in swallowing disappears, and the general health improves. In Nogier's cases this improvement was maintained for several years. The advantages of X-ray treatment over other methods, according to the author, are that it is simple and painless and does not expose the patient to the risks of hæmorrhage or infection. (B.M.J.)

F. H. WILLIAMS (*Paris méd.*, February 3rd, 1923, p. 110) states that the rationale of radium treatment consists in the fact that the lymphoid tissue of which the tonsils are composed is particularly susceptible to the action of radium, and that diseased tonsillar tissue is even less resistant than the same tissue in the normal state. Radium, however, cannot be expected to have any action on fibrous tissue or suppuration. Williams has treated 101 cases, aged from five to sixty years, which he classifies as follows: enlarged tonsils without inflammation, 44 cases; tonsillitis (2 acute, 31 chronic), 33 cases; enlarged tonsils with various complications, such as rheumatism,

cardiac disease, and nephritis, 14 cases. In all but three of the cases of simple enlargement, and in all but two of the tonsillitis cases, the tonsils were considerably reduced in size as the result of treatment. The use of radium is not without danger, and should only be carried out by an expert. Radium is stated to be more suitable than X rays for enlarged tonsils, because it is easier to determine the exact dose, and because the radiations are applied to the tonsils by the mouth and are almost entirely absorbed by the tonsils themselves, whereas X rays, which are applied externally, are in great part absorbed by the intervening tissue, especially the parotid.

(B.M.J.)

Skin Cancer following Exposure to Radium.—W. J. MACNEIL and G. W. WILLIS (*Journ. Amer. Med. Assoc.*, Feb. 17th, 1923, p. 466) report an interesting case of skin cancer, following exposure to radium, which occurred in a medical practitioner aged forty-six. This patient worked with X rays in his practice from 1905 to 1917, but not since; he was fully cognisant of the danger of X-ray burns and precautions for self-protection were carefully employed. From 1912 to June, 1920, however, he handled radium without any precautions for self-protection; he used it in small amounts up to 1915, but in quite large amounts from 1915 to 1920, 200 to 365 mg. in individual tubes being taken between the right thumb and forefinger almost every day. Various changes, which might be ascribed to the exposure to radium, began to be observed late in 1918, and since early in 1920 the skin changes required constant care. In September, 1922, a fissure on the ball of the right thumb underwent a peculiar and extremely painful alteration in character, and did not improve under various treatments. The central portion of the lesion was excised, and on microscopical examination was found to be a disintegrating squamous-celled carcinoma, extending beyond the limits of the specimen examined. Immediate amputation of the thumb was advised, and this was carried out on the following day. The condition was then found, on further examination, to be a squamous-celled carcinoma of the distal phalanx of the right thumb, extending to the base of the phalanx; there were hyperkeratosis

and parakeratosis of the cutaneous epithelium. The authors admit that the earlier work of the patient with X rays throws some little doubt on the causal relation of the radium. On the evidence, however, they are strongly inclined to the opinion that radium may, when exposure has been sufficient, give rise to changes in the skin predisposing to development of malignant new growth, and that the radium had precisely this effect in the case reported.

(B.M.J.)

The Value of Perirenal Inflation.—M. CHEVASSU (*Bull. et Mém. Chir. de Paris*, Feb., 6th, 1923, p. 189) gives the results of over a year's experience of perirenal inflation. The technique of the operation is simple, but the results are often unsatisfactory, as there are a number of spaces round the kidney which may become injected instead of the perirenal tissue. These include the peritoneum, pleura, or mediastinum, which may rarely be injected, or more commonly the muscular planes, of the psoas muscle in particular; where this muscle is thick the point of the needle may be arrested in its sheath and the gas be injected among the muscle fibres, or sometimes it may result in the injection entering the central ligament of the diaphragm and thence passing to the chest or downwards into the abdomen. The author's procedure differs from that of Carelli in that he makes the injection at the point where the kidney approaches nearest to the skin; this point lies at the upper point of the line which divides the muscles of the back from those of the abdomen over the apex of Petit's triangle. He employs the trocar used to produce artificial pneumothorax; even so, it is impossible to be sure the injection will proceed satisfactorily, and it may merely enter in the pararenal layer. When successful the kidney can be shown surrounded by the gas and separated from neighbouring structures. When the injection does not spread equally around the kidney, it may be due to perinephritis or to the gas collecting in pockets, and this leads to mistakes in diagnosis. The author concludes that at present no technique so far designed will give constant results. The image obtained by this method is often difficult of interpretation and no better than an ordinary radiogram; it may sometimes be used with advantage in cases of tumours of the

loin where the diagnosis is obscure and other methods have been tried without success.

(B.M.J.)

X-ray Prints: A Suggestion.—A. P. BERTWISTLE (*Brit. Jour. Surg.*, Vol. X, No. 39, p. 357).—Bertwistle has devised a method whereby he has defined the outline of the soft parts in such a way as to render skiagrams more realistic. Whilst skin shows quite clearly on the negative, it does not do so on a print, though occasionally the apparent soft parts are represented by structures deep to the deep fascia. Bertwistle took a series of negatives, and with a point outlined the skin. The background was subsequently filled in with Indian ink. The prints illustrating this method in the *British Journal of Surgery* are excellent and should be very useful for textbook illustrations.

C. P. G. W.

The Biological Effect of X rays of Different Wave-Lengths.—In *Strahlentherapie*, Vol. XIV, page 558, there is an interesting communication by Professor Martius, of Bonn, on this subject.

Krönig and Friedrich came to the conclusion, after many experiments, that there is no difference in the biological effects between the X rays of the various wave-lengths which are used at present. Holthusen proved later on that the ionising effect of hard rays could not attain its maximum in the small ionising chamber used by Friedrich, and that with an ionising chamber of larger size the effect on the air and the biological effect do not run parallel, the latter becoming smaller as the X rays become harder.

He used for comparison the ionising effect, but for us it is important to know, what is the biological effect of rays of different length when similar quantities have been absorbed? This question can be answered only when the relation between the quantity of absorbed X-ray energy and the amount of ionisation which it produces is known. The comparison of the ionising effects alone are of no value when we know that different wave-lengths produce different degrees of ionisation, but do not know what the variation is.

The experiments of Grebe have thrown light on this question. He measured the increase of temperature due to the absorption of X rays, and proved that a certain quantity

of absorbed soft rays has a much greater ionising effect on the air than a similar quantity of absorbed hard rays; in other words, to produce the same degree of ionisation a greater quantity of hard rays must be absorbed than of soft ones.

It thus becomes possible to find the relation between absorbed energy and biological effect.

A small ionising chamber, as described by Friedrich, was calibrated biologically, and it was found that, when compared with the indications of this chamber, similar quantities of X rays of different wave-length produce similar effects on the skin and on the seeds of beans for absorption coefficients greater than $\mu = 0.162$ in water.

Having found this, we have only to examine the biological effect of the radiations which had been investigated by Grebe. The two wave-lengths which were employed were 0.325 A.U. and 0.56 A.U., and the following values were found:—

For wave-lengths of.	0.325 and 0.56 A.U.
Intensity.	1 „ 1
Quantity absorbed to produce equal ionising effects	3.4 „ 1
Quantity absorbed to produce equal biological effects	3.9 „ 1

In other words, when similar intensities of X rays of different wave-length are available, the ionising effect of hard rays is smaller, and the biological effect is smaller still than that of softer rays. To produce the same biological effect, 3.9 times more of the hard rays have to be absorbed than of the soft ones, or, when similar quantities have been absorbed, rays with a wave-length of 0.56 have, biologically, 3.9 times as great an effect as rays with a wave-length of 0.325.

The question, what produces the biological effect? is not yet solved. It is a transformation of energy, which becomes smaller as the wave-length decreases. And the further question, is there, in addition to this difference in quantity, also a difference in quality? may hard rays, in spite of their small quantitative effect, produce better results? can be decided only by clinical observations. The results of experiments which are being made in this direction will be published later on.

W. E. SCHALL.

Osteitis with Multiple Cysts and its Etiology.—N. VOORHOEVE, Amsterdam (*Acta Radiologica*, Vol. II, Fasc. 1, pp. 40-56).—A description of a case of osteitis multiplex cystica.

A critique of cases published up till now.

The tubercular nature of the disease is not yet proved.

A new support in favour of its tubercular origin.

The attention is drawn to the existence of a spinal affection in a typical case; the lesions are especially found in those nerve-centres which are related to the parts affected by the osteitis.

The hypothesis is advanced that not only a tubercular infection is necessary for the development of an osteitis multiplex cystica, but also an alteration in the trophical centres of the fingers and toes.

The alterations in the spinal vessels, described by Achard and others, are perhaps in some cases of tubercular origin.

Studies on the Influence of the Roentgen and Radium Rays on Phagocytosis.—AXEL WESTMAN, Stockholm (*Acta Radiologica*, Vol. II, H. 1, pp. 57-69).—By means of a somewhat modified form of Wright's method for opsonic determinations, the author has carried out investigations upon the question as to whether the therapeutic roentgen and radium irradiations have any appreciable influence on the phagocytic function of the leucocytes. On these occasions the phagocytosis has been examined before and after treatment, first, in patients with uterine cancer, which in most of the cases has been treated exclusively by radium; secondly, in several cases of hidradenitis that have been roentgen treated; likewise also in one case of post-operative prophylactic roentgen treatment. In all these cases the radiological treatment has been shown to have a more or less marked stimulating effect on the phagocytosis. This is of special interest concerning cases with hidradenitis, as we hereby seem to obtain a contribution to the explanation of the beneficial influence of the roentgen rays on inflammatory processes.

A Peculiar Kidney-Stone Case.—G. RESECK, Stockholm (*Acta Radiologica*, Vol. II, Fasc. 1, pp. 31-37).—The author relates a case of nephrolithiasis on the right side, with about a hundred faceted concretion shadows of equal

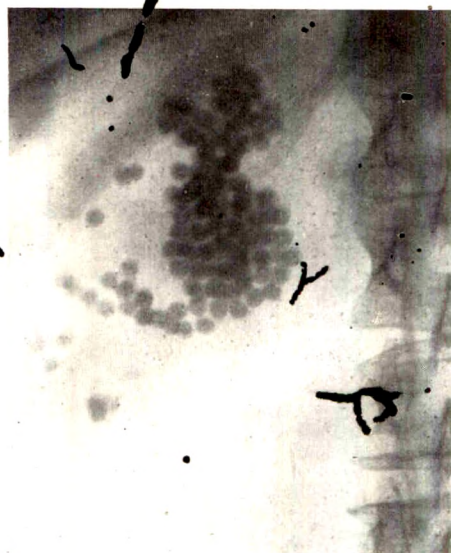


FIG. 1.

General view of the right kidney region.



FIG. 2.

Right lateral position.

size and of typical gall-stone appearance, the diagnosis of which case could only be determined by radiographing the patient in various lateral positions, whereby a fine picture of the dilated kidney pelvis was obtained. Pyelography was contraindicated.

PUBLICATIONS RECEIVED.

Books.

De l'Emploi des Rayons X en Stomatologie.
By Dr. W. DUFOURGER. (Paris: A. Maloine
et Fils.)

Journals.

Archives d'Electricité Medicale, April, 1923.

Archives de Médecine et de Pharmacie Militaires, October, November, December, 1922.

Archivio Italiano di Chirurgia, April, 1923.

British Journal of Dermatology and Syphilis, May, 1923.

Bulletin of the Johns Hopkins Hospital, May, 1923.

Bulletin et Memoires de la Société de Radiologie Medicale de France, April, 1923.

Bulletin Officiel de la Société Française d'Electrotherapie, April, 1923.

La Chirurgia degli Organi di Movimento, April, 1923.

Health, May, 1923.

Hospitalstidende, March 28th; April 4th, 11th, 18th, 25th; May 2nd, 9th, 1923.

The International Journal of Orthodontia, Oral Surgery and Radiography, April, 1923.

The Journal of Laryngology and Otology, June, 1923.

Journals—continued.

Journal de Médecine de Bordeaux, May 10th, 1923.

Journal de Médecine de Lyon, May 5th, 1923.

Journal de Radiologie et d'Electrologie, April, 1923.

Journal of Radiology, May, 1923.

Kongresszentralblatt für die Gesamte Innere Medizin und Ihre Grenzgebiete, April 30th; May 7th, 14th, 21st, 1923.

Medical Journal of Australia, March 17th, 24th, 31st; April 7th, 1923.

Medical Science, June, 1923.

New York Medical Journal, May 2nd, 16th, 1923.

New York State Journal of Medicine, May, 1923.

Norsk Magazin for Lægevidenskaben, April, 1923.

Il Policlinico, April 15th; May 1st, 1923.

La Radiologia Medica, April, May, 1923.

La Revue de Stomatologie, April, 1923.

Strahlentherapie, Band XV, Heft 1, 2; Band XIV, Heft 4, 1923.

Surgery, Gynaecology, and Obstetrics, May, 1923.

Ugeskrift for Læger, April 26th, 1923.

Urologic and Cutaneous Review, May, 1923.

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